e-Front runners

STARTING GUIDE
FRENIC Multi

High performance compact inverter

3 ph 400 V 0.4 kW-15 kW
3 ph 200 V 0.1 kW-15 kW
1 ph 200 V 0.1 kW-2.2 kW

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CONTENTS

Chapter		Page
1.	SAFETY INFORMATION AND CONFORMITY TO STANDARDS	1
1.1	Safety information	1
1.2	Conformity to European Standards	5
2.	MECHANICAL INSTALLATION	6
2.1	Operating Environment	6
2.2	Installing the inverter	6
3.	WIRING	8
3.1	Removing the terminal cover and the main circuit terminal block cover	8
3.2	Wiring for main circuit terminals and grounding terminals	10
3.3	Wiring for control circuit terminals	10
3.4	Connection diagram	16
3.5	Setting up the slide switches	17
4.	OPERATION USING THE KEYPAD	19
5.	QUICK START COMMISSION	21
5.1	Inspection and preparation prior to powering up	21
5.2	Setting the function codes	21
5.3	Quick start commissioning (auto tuning)	21
5.4	Operation	22
6.	FUNCTION CODES AND APPLICATION EXAMPLES	23
6.1	Function codes tables	23
6.2	Application Examples with FRENIC Multi	35
6.2.1	Preset speeds (multistep frequencies) selection	35
6.2.2	Dancer control using PID control block	36
7.	TROUBLESHOOTING	37
8.	SPECIFICATIONS AND EXTERNAL DIMENSIONS	39
8.1	Specifications	39
8.1.1	Three-phase 200 V class series	39
8.1.2	Three-phase 400 V class series	40
8.1.3	Single phase 200 V class series	41
8.2	External dimensions	42
8.2.1	Inverter dimensions	42
8.2.2	Standard keypad dimensions	47
9.	OPTIONS	49
9.1	Options table	49
9.2	EMC input filter	50
9.3	DC reactor	50
9.3.1	Standard DC reactors	50
9.3.2	DC reactors for EN12015 compliance	50

Preface

Thank you for purchasing our FRENIC-Multi series of inverters.
This product is designed to drive a three-phase induction motor for many types of application.
Read through this manual and be familiar with correct handling and operation of this product.
Improper handling may result in incorrect operation, a short life, or even a failure of this product as well as the motor.
Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
Listed below are the other materials related to the use of the FRENIC-Multi. Read them in conjunction with this manual if necessary.

- FRENIC-Multi User's Manual (MEH457)
- FRENIC-Multi Instruction Manual (INR-SI47-1094-E)
- RS-485 Communication User's Manual (MEH448b)
- PG option card (OPC-E1-PG) Instruction Manual (INR-SI47-1118-E)
- PG option card (OPC-E1-PG3) Instruction Manual (INR-SI47-1142a-E)
- FRENIC-Multi Catalogue (MEH653a)
- Mounting adapter for External Cooling “PB-F1/E1” Installation Manual (INR-SI47-0880a)

The materials are subject to change without notice. Be sure to obtain the latest editions for use.

1. SAFETY INFORMATION AND CONFORMITY TO STANDARDS

1.1 Safety information

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.
Safety precautions are classified into the following two categories in this manual.

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

Application

⚠WARNING

- FRENIC-Multi is designed to drive a three-phase induction motor. Do not use it for single-phase motors or for other purposes.
  Fire or an accident could occur.
- FRENIC-Multi may not be used for a life-support system or other purposes directly related to the human safety.
- Though FRENIC-Multi is manufactured under strict quality control, install safety devices for applications where serious accidents or material losses are foreseen in relation to the failure of it.
  An accident could occur.

Installation

⚠WARNING

- Install the inverter on a nonflammable material such as metal.
  Otherwise fire could occur.
- Do not place flammable object nearby.
  Doing so could cause fire.

⚠CAUTION

- Do not support the inverter by its terminal block cover during transportation.
  Doing so could cause a drop of the inverter and injuries.
- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
  Otherwise, a fire or an accident might result.
- Do not install or operate an inverter that is damaged or lacking parts.
  Doing so could cause fire, an accident or injuries.
- Do not stand on a shipping box.
- Do not stack shipping boxes higher than the indicated information printed on those boxes.
  Doing so could cause injuries.

Wiring

⚠WARNING

- When wiring the inverter to the power supply, insert a recommended moulded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of power lines. Use the devices within the recommended current range.
- Use wires of the specified size.
- When wiring the inverter to the power supply that is 500 kVA or more, be sure to connect an optional DC reactor (DCR).

  Otherwise, fire could occur.

- Do not use one multicore cable in order to connect several inverters with motors.
- Do not connect a surge killer to the inverter's output (secondary) circuit.

  Doing so could cause fire.

- Ground the inverter in compliance with the national or local electric code.

  Otherwise, electric shock could occur.

- Qualified electricians should carry out wiring.
- Disconnect power before wiring.

  Otherwise, electric shock could occur.

- Install inverter before wiring.

  Otherwise, electric shock or injuries could occur.

⚠WARNING

- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.

  Otherwise fire or an accident could occur.

- Do not connect the power supply wires to output terminals (U, V, and W).
- Do not insert a braking resistor between terminals P (+) and N (-), P1 and N (-), P (+) and P1, DB and N (-), or P1 and DB.

  Doing so could cause fire or an accident.

- Generally, control signal wires are not reinforced insulation. If they accidentally touch any of live parts in the main circuit, their insulation coat may break for any reasons. In such a case, ensure the signal control wire is protected from making contact with any high voltage cables.

  Doing so could cause an accident or electric shock.

⚠CAUTION

- Connect the three-phase motor to terminals U, V, and W of the inverter.

  Otherwise injuries could occur.

- The inverter, motor and wiring generate electric noise. Ensure preventative measures are taken to protect sensors and sensitive devices from rfi noise..

  Otherwise an accident could occur.

Operation

⚠WARNING

- Be sure to install the terminal cover before turning the power ON. Do not remove the covers while power is applied.

  Otherwise electric shock could occur.

- Do not operate switches with wet hands.

  Doing so could cause electric shock.

- If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping.
  (Design the machinery or equipment so that human safety is ensured after restarting.)
- If the stall prevention function (current limiter), automatic deceleration, and overload prevention control have been selected, the inverter may operate at an acceleration/deceleration time or frequency different from the commanded ones. Design the machine so that safety is ensured even in such cases.

  Otherwise an accident could occur.

⚠WARNING

- The STOP key on the keypad is effective only when the keypad operation is enabled with function code F02 (= 0, 2 or 3). When the keypad operation is disabled, prepare an emergency stop switch separately for safe operations.

  Switching the run command source from keypad (local) to external equipment (remote) by turning ON the "Enable communications link" command ***LE*** disables the STOP key. To enable the STOP key for an emergency stop, select the STOP key priority with function code H96 (= 1 or 3).
- If an alarm reset is made with the Run command signal turned ON, the inverter may start immediately. Ensure that the Run command signal is turned OFF in advance.

  Otherwise an accident could occur.
- If you enable the "Restart mode after momentary power failure" (Function code F14 = 4 or 5), then the inverter automatically restarts running the motor when the power is recovered.

  (Design the machinery or equipment so that human safety is ensured after restarting.)
- Ensure you have read and understood the manual before programming the inverter, incorrect parameter settings may cause damage to the motor or machinery.

  An accident or injuries could occur.
- Do not touch the inverter terminals while the power is applied to the inverter even if the inverter is in stop mode.

  Doing so could cause electric shock.

⚠CAUTION

- Do not turn the main circuit power (circuit breaker) ON or OFF in order to start or stop inverter operation.
  Doing so could cause failure.
- Do not touch the heat sink and braking resistor because they become very hot.
  Doing so could cause burns.
- Before setting the speeds (frequency) of the inverter, check the specifications of the machinery.
- The brake function of the inverter does not provide mechanical holding means.
  Injuries could occur.

Maintenance and inspection, and parts replacement

⚠WARNING

- Turn the power OFF and wait for at least five minutes before starting inspection. Further, check that the LED monitor is unlit and that the DC link bus voltage between the P (+) and N (-) terminals is lower than 25 VDC.
  Otherwise, electric shock could occur.
- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.
  Otherwise, electric shock or injuries could occur.

Disposal

⚠CAUTION

- Treat the inverter as an industrial waste when disposing of it.
  Otherwise injuries could occur.

Others

⚠WARNING

- Never attempt to modify the inverter.
  Doing so could cause electric shock or injuries.

Precautions for use

In running general-purpose motors	Driving a 400 V general-purpose motor	When driving a 400V general-purpose motor with an inverter using extremely long wires, damage to the insulation of the motor may occur. Use an output circuit filter (OFL) if necessary after checking with the motor manufacturer.
	Torque characteristics and temperature rise	When the inverter is used to run a general-purpose motor, the temperature of the motor becomes higher than when it is operated using a commercial power supply. In the low-speed range, the cooling effect will be weakened, so decrease the output torque of the motor.
	Vibration	When an inverter-driven motor is mounted to a machine, resonance may be caused by the natural frequencies of the machine system. Note that operation of a 2-pole motor at 60 Hz or higher may cause abnormal vibration. * The use of a rubber coupling or vibration-proof rubber is recommended. * Use the inverter's jump frequency control feature to skip the resonance frequency zone(s).
	Noise	When an inverter is used with a general-purpose motor, the motor noise level is higher than that with a commercial power supply. To reduce noise, raise carrier frequency of the inverter. Operation at 60 Hz or higher can also result in higher noise level.
In running special motors	High-speed motors	If the reference frequency is set to 120 Hz or more to drive a high-speed motor, test-run the combination of the inverter and motor beforehand to check for safe operation.
	Explosion-proof motors	When driving an explosion-proof motor with an inverter, use a combination of a motor and an inverter that has been approved in advance.
	Submersible motors and pumps	These motors have a larger rated current than general-purpose motors. Select an inverter whose rated output current is greater than that of the motor. These motors differ from general-purpose motors in thermal characteristics. Set a low value in the thermal time constant of the motor when setting the electronic thermal function.
	Brake motors	For motors equipped with parallel-connected brakes, their power supply for brake must be supplied from the primary circuit. If the power supply for brake is connected to the inverter's output circuit, the brake will not work. Do not use inverters for driving motors equipped with series-connected brakes.
	Geared motors	If the power transmission mechanism uses an oil-lubricated gearbox or speed changer/reducer, then continuous operation at low speed may cause poor lubrication. Avoid such operation.
In running special motors	Synchronous motors	It is necessary to take special measures suitable for this motor type. Contact your Fuji Electric representative for details.
	Single-phase motors	Single-phase motors are not suitable for inverter-driven variable speed operation. Use three-phase motors. In the event of a single phase supply to the inverter, a three phase motor must still be used as the inverter outputs three phase only.
Environ-mental conditions	Installation location	Use the inverter within the ambient temperature range from -10 to +50°C. The heat sink and braking resistor of the inverter may become hot under certain operating conditions, install the inverter on nonflammable material such as metal. Ensure that the installation location meets the environmental conditions specified in Chapter 2, Section 2.1 "Operating Environment."
Combina-tion with peripheral devices	Installing an MCCB or RCD/ELCB	Install a recommended moulded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the primary circuit of the inverter to protect the wiring. Ensure that the circuit breaker rated current is equivalent to or lower than the recommended rated current.
	Installing an MC in the secondary circuit	If a magnetic contactor (MC) is mounted in the inverter's output (secondary) circuit for switching the motor to commercial power or for any other purpose, ensure that both the inverter and the motor are completely stopped before you turn the MC ON or OFF. Do not install magnetic contactors with built-in surge killer on the output of the inverter (secondary circuit).
	Installing an MC in the primary circuit	Do not turn the magnetic contactor (MC) in the primary circuit ON or OFF more than once per hour as an inverter failure may result. If frequent starts or stops are required during motor operation, use terminal [FWD]/[REV] signals or the RUN/STOP key.
	Protecting the motor	The electronic thermal function of the inverter can protect the motor. The operation level and the motor type (general-purpose motor, inverter motor) should be set. For high-speed motors or water-cooled motors, set a small value for the thermal time constant and protect the motor. If you connect the motor thermal relay to the motor with a long wire, a high-frequency current may flow into the wiring stray capacitance. This may cause the relay to trip at a current lower than the set value for the thermal relay. If this happens, lower the carrier frequency or use the output circuit filter (OFL).

Combination with peripheral devices	Discontinuance of power capacitor for power factor correction	Do not mount power capacitors for power factor correction in the inverter's primary circuit. (Use the DC reactor to correct the inverter power factor.) Do not use power capacitors for power factor correction in the inverter's output (secondary) circuit. An overcurrent trip will occur, disabling motor operation.
	Discontinuance of surge killer	Do not connect a surge killer to the inverter's output (secondary) circuit.
	Reducing noise	Use of a filter and shielded wires is typically recommended to satisfy EMC Directive.
	Measures against surge currents	If an overvoltage trip occurs while the inverter is stopped or operated under a light load, it is assumed that the surge current is generated by open/close of the power capacitor for power factor correction in the power system. * Connect a DC reactor to the inverter.
	Megger test	When checking the insulation resistance of the inverter, use a 500 V megger and follow the instructions contained in Chapter 7, Section 7.5 "Insulation Test" of FRENIC Multi Instruction Manual (INR-SI47-1094-E).
Wiring	Control circuit wiring length	When using remote control, limit the wiring length between the inverter and operator panel to 20 m or less and use twisted pair or shielded cable.
	Wiring length between inverter and motor	If a long cable run is required between the inverter and the motor, the inverter may overheat or trip as a result of overcurrent (high-frequency current flowing into the stray capacitance) in the cables connected to the phases. Ensure that the wiring is shorter than 50 m. If this length must be exceeded, lower the carrier frequency or mount an output circuit filter (OFL).
	Wiring size	Select cables with a sufficient capacity by referring to the current value or recommended wire size.
	Wiring type	When several inverters drive motors, do not use one multicore cable in order to connect several inverters with motors.
	Grounding	Securely ground the inverter using the grounding terminal.
Selecting inverter capacity	Driving general-purpose motor	Select an inverter according to the nominal applied motor rating listed in the standard specifications table for the inverter. When high starting torque is required or quick acceleration or deceleration is required, select an inverter with one size larger capacity than the standard.
	Driving special motors	Select an inverter that meets the following condition: Inverter rated current > Motor rated current
Transportation and storage	When transporting or storing inverters, follow the procedures and select locations that meet the environmental conditions listed in Chapter 1, Section 1.3 "Transportation" and Section 1.4 "Storage Environment" of FRENIC Multi Instruction Manual (INR-SI47-1094-E).	

1.2 Conformity to European standards

The CE marking on Fuji Electric products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 89/336/EEC issued by the Council of the European Communities and the Low Voltage Directive 73/23/EEC.

Inverters with built-in EMC filter that bear a CE marking are in conformity with EMC directives. Inverters having no built-in EMC filter can be in conformity with EMC directives if an optional EMC compliant filter is connected to them.

General purpose inverters are subject to the regulations set forth by the Low Voltage Directive in the EU. Fuji Electric declares the inverters bearing a CE marking are compliant with the Low Voltage Directive.

FRENIC Multi inverters are in accordance with the regulations of following council directives and their amendments:

EMC Directive 89/336/EEC (Electromagnetic Compatibility)

Low Voltage Directive 73/23/EEC (LVD)

For assessment of conformity the following relevant standards have been taken into consideration:

EN61800-3:2004

EN50178:1997

2. MECHANICAL INSTALLATION

2.1 Operating Environment

Install the inverter in an environment that satisfies the requirements listed in Table 2.1.

Table 2.1 Environmental Requirements

Item	Specifications	
Site location	Indoors	
Ambient temperature	-10 to +50°C (Note 1)	
Relative humidity	5 to 95% (No condensation)	
Atmosphere	The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gas, oil mist, vapor or water drops. (Note 2) The atmosphere must contain only a low level of salt. (0.01 mg/cm^2 or less per year) The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.	
Altitude	1000 m max. (Note 3)	
Atmospheric pressure	86 to 106 kPa	
Vibration	3 mm (Max. amplitude) 9.8 m/s^2 2 m/s^2 1 m/s^2	2 to less than 9 Hz 9 to less than 20 Hz 20 to less than 55 Hz 55 to less than 200 Hz

Table 2.2 Output Current Derating Factor in Relation to Altitude

Altitude	Output current derating factor
1000 m or lower	1.00
1000 to 1500 m	0.97
1500 to 2000 m	0.95
2000 to 2500 m	0.91
2500 to 3000 m	0.88

(Note 1) When inverters are mounted side-by-side without any gap between them (less than 5.5 kW), the ambient temperature should be within the range from -10 to +40°C.

(Note 2) Do not install the inverter in an environment where it may be exposed to cotton waste or moist dust or dirt which will clog the heat sink in the inverter. If the inverter is to be used in such an environment, install it in the panel of your system or other dustproof containers.

(Note 3) If you use the inverter in an altitude above 1000 m, you should apply an output current derating factor as listed in Table 2.2.

2.2 Installing the Inverter

(1) Mounting base

The temperature of the heat sink will rise up to approx. 90°C during operation of the inverter, so the inverter should be mounted on a base made of material that can withstand temperatures of this level.

⚠WARNING

Install the inverter on a base constructed from metal or other non-flammable material.

A fire may result with other material.

(2) Clearances

Ensure that the minimum clearances indicated in Figure 2.1 are maintained at all times. When installing the inverter in the panel of your system, take extra care with ventilation inside the panel as the temperature around the inverter will tend to increase. Do not install the inverter in a small panel with poor ventilation.

Figure 2.1 Mounting Direction and Required Clearances

■ **When mounting two or more inverters**

Horizontal layout is recommended when two or more inverters are to be installed in the same unit or panel. If it is necessary to mount the inverters vertically, install a partition plate or the like between the inverters so that any heat radiating from an inverter will not affect the one/s above. As long as the ambient temperature is 40℃ or lower, inverters can be mounted side-by-side without any gap between them (only for inverters with a capacity of less than 5.5 kW).

■ **When employing external cooling**

At the shipment time, the inverter is set up for mount inside your equipment or panel so that cooling is done all internally.

To improve cooling efficiently, you can take the heat sink out of the equipment or the panel (as shown in Figure 2.2) so that cooling is done both internally and externally (this is called "external cooling").

In external cooling, the heat sink, which dissipates about 70% of the total heat (total loss) generated into air, is situated outside the equipment or the panel. As a result, much less heat is radiated inside the equipment or the panel.

To take advantage of external cooling, you need to use the external cooling attachment option for inverters with a capacity of 5.5 kW or above.

In an environment with high humidity or high levels of fibrous dust, do not use external cooling, as this will clog the heat sink.

🕮 For details, refer to the Mounting Adapter for External Cooling "PB-F1/E1" Installation Manual (INR-SI47-0880a).

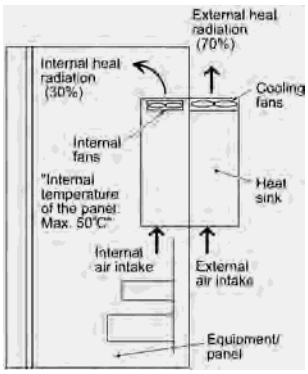


Figure 2.2 External Cooling

⚠CAUTION

Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.

This may result in a fire or accident.

3. WIRING

Follow the procedure below (In the following description, the inverter has already been installed).

3.1 Removing the terminal cover and the main circuit terminal block cover

(1) For inverters with a capacity of less than 5.5 kW

① To remove the terminal cover, put your finger in the dimple of the terminal cover (labeled "PULL"), and then pull it up toward you.

② To remove the main circuit terminal block cover, hold its right and left ends with your fingers and slide it toward you.

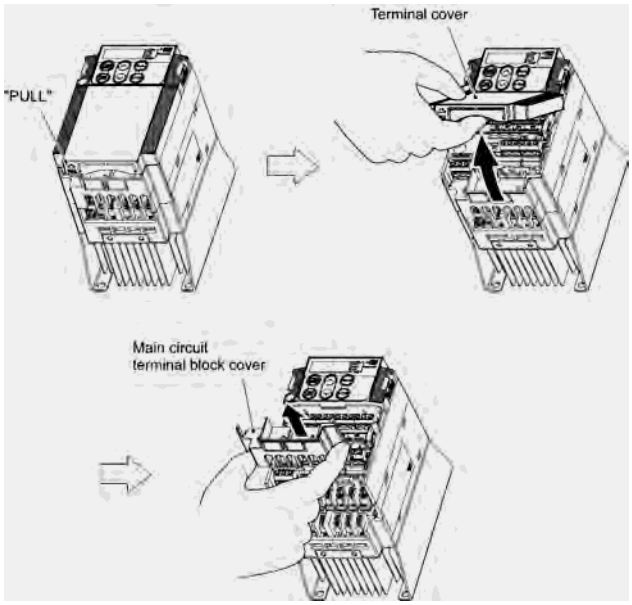


Figure 3.1 Removing the Covers (For Inverters with a Capacity of Less Than 5.5 kW)

(2) For inverters with a capacity of 5.5 and 7.5 kW

① To remove the terminal cover, first loosen the terminal cover fixing screw, put your finger in the dimple of the terminal cover (labeled "PULL"), and then pull it up towards you.

② To remove the main circuit terminal block cover, put your thumbs on the handles of the main circuit terminal block cover, and push it up while supporting it with your fingers (Refer to Figure 3.2).

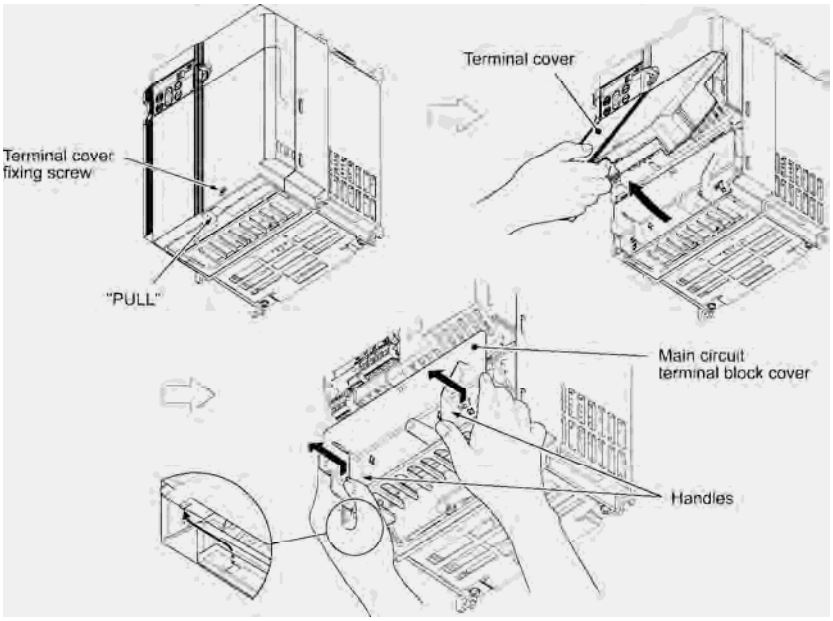


Figure 3.2 Removing the Covers (For Inverters with a Capacity of 5.5 and 7.5 kW)

Note When mounting the main circuit terminal block cover, fit it according to the guide on the inverter.

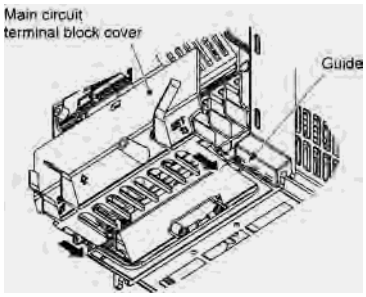


Figure 3.3 Mounting the main circuit terminal block cover
(For Inverters with a Capacity of 5.5 and 7.5 kW)

(3) For inverters with a capacity of 11 and 15 kW

① To remove the terminal cover, first loosen the terminal cover fixing screw, put your finger in the dimple of the terminal cover (labeled "PULL"), and then pull it up towards you.

② To remove the main circuit terminal block cover, hold the handles on the both sides of the main circuit terminal block cover, and pull it up.

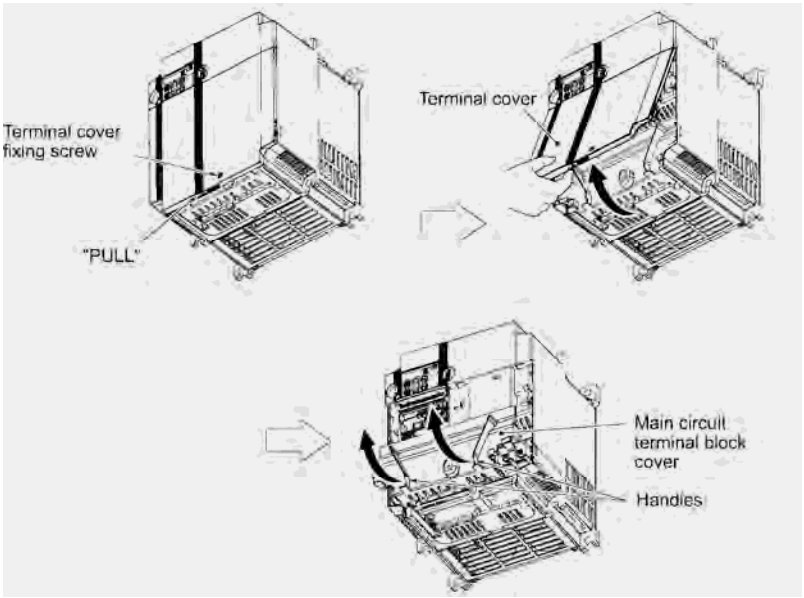


Figure 3.4 Removing the Covers (For Inverters with a Capacity of 11 and 15 kW)

Note When mounting the main circuit terminal block cover, fit it according to the guide on the inverter.

① Insert the main circuit terminal block cover by fitting the part labeled "GUIDE" according to the guide on the inverter.

② Push where "PUSH" are labeled to snap it into the inverter.

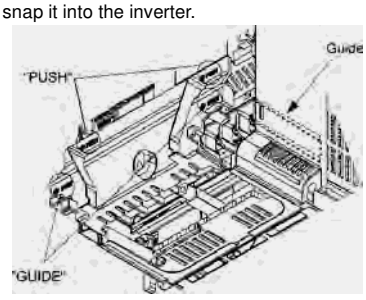


Figure 3.5 Mounting the Main Circuit Terminal Block Cover
(For Inverters with a Capacity of 11 and 15 kW)

3.2 Wiring for main circuit terminals and grounding terminals

Table 3.1 shows the main circuit power terminals and grounding terminals.

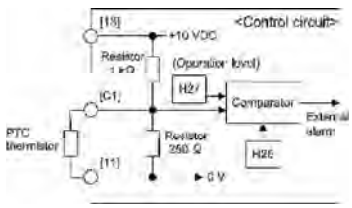
Table 3.1 Symbols, Names and Functions of the Main Circuit Power Terminals

Symbol	Name	Functions
L1/R, L2/S, L3/T or L1/L, L2/N	Main circuit power inputs	Connect the three-phase input power lines or single-phase input power lines
U, V, W	Inverter outputs	Connect a three-phase motor.
P1, P(+)	DC reactor connection	Connect an optional DC reactor (DCRE) for improving power factor.
P(+), DB	DC braking resistor	Connect an optional braking resistor.
P(+), N(-)	DC link bus	Connect a DC link bus of other inverter(s). An optional regenerative converter is also connectable to these terminals.
⏚G	Grounding for inverter and motor	Grounding terminals for the inverter's chassis (or case) and motor. Earth one of the terminals and connect the grounding terminal of the motor. Inverters provide a pair of grounding terminals that function equivalently.

3.3 Wiring for control circuit terminals

Table 3.2 lists the symbols, names and functions of the control circuit terminals. The wiring to the control circuit terminals differs depending upon the setting of the function codes, which reflects the use of the inverter. Route wires properly to reduce the influence of noise.

Table 3.2 Symbols, Names and Functions of the Control Circuit Terminals

Classification	Symbol	Name	Functions
Analogue input	[13]	Power supply for the potentiometer	Power supply (+10 VDC) for frequency command potentiometer (Potentiometer: 1 to 5kΩ) The potentiometer of 1/2 W rating or more should be connected.
	[12]	Analogue setting voltage input	(1) The frequency is commanded according to the external analogue input voltage. • 0 to ±10 VDC/0 to ±100% (Normal operation) • ±10 to 0 VDC/0 to ±100% (Inverse operation) (2) Inputs setting signal (PID command value) or feedback signal. (3) Used as additional auxiliary setting to various frequency settings. • Input impedance: 22kΩ • The maximum input is +15 VDC, however, the current larger than ±10 VDC is handled as ±10 VDC. **Note:** Inputting a bipolar analogueue voltage (0 to ±10 VDC) to terminal [12] requires setting function code C35 to "0."
	[C1]	Analogue setting current input (C1 function)	(1) The frequency is commanded according to the external analogue input current. • 4 to 20 mA DC/0 to 100% (Normal operation) • 20 to 4 mA DC/0 to 100 % (Inverse operation) (2) Inputs setting signal (PID command value) or feedback signal. (3) Used as additional auxiliary setting to various frequency settings. • Input impedance: 250Ω • Maximum input is +30 mA DC, however, the current larger than +20 mA DC is handled as +20 mA DC.
		Analogue setting voltage input (V2 function)	(1) The frequency is controlled according to the external analogueue input voltage. • 0 to +10 VDC/0 to +100 % (Normal operation) • +10 to 0 VDC/0 to +100 % (Inverse operation) (2) Inputs setting signal (PID command value) or feedback signal. (3) Used as additional auxiliary setting to various frequency settings. • Input impedance: 22 kΩ • Maximum input is +15 VDC, however, the voltage larger than +10 VDC is handled as +10 VDC.
		PTC thermistor input (PTC function)	(1) Connects PTC (Positive Temperature Coefficient) thermistor for motor protection. The figure shown below illustrates the internal circuit diagram. To use the PTC thermistor, you must change data of the function code H26.  Figure 3.6 Internal Circuit Diagram
		The C1 function, V2 function, or PTC function can be assigned to terminal [C1]. Doing so requires setting the slide switch on the interface PCB and configuring the related function code. For details, refer to Section 3.5, "Setting up the slide switches".	
	[11]	Analogue common	Common for analogue input/output signals ([13], [12], [C1], and [FM]) Isolated from terminals [CM]s and [CMY].

Classification	Symbol	Name	Functions
Analogue input	Note		- Since low level analogue signals are used, these signals are especially susceptible to the external noise effects. Route the wiring as short as possible (within 20 m) and use shielded wires. In principle, ground the shielded sheath of wires; if effects of external inductive noises are considerable, connection to terminal [11] may be effective. As shown in Figure 3.7, ground the single end of the shield to enhance the shield effect. - Use a twin contact relay for low level signals if the relay is used in the control circuit. Do not connect the relay's contact to terminal [11]. - When the inverter is connected to an external device outputting the analogue signal, a malfunction may be caused by electric noise generated by the inverter. If this occurs, connect a ferrite core (a toroidal core or an equivalent) to the device outputting the analogue signal and/or connect a capacitor having the good cut-off characteristics for high frequency between control signal wires as shown in Figure 2.14. - Do not apply a voltage of +7.5 VDC or higher to terminal [C1] when you assign the terminal [C1] to C1 function. Doing so could damage the internal control circuit.

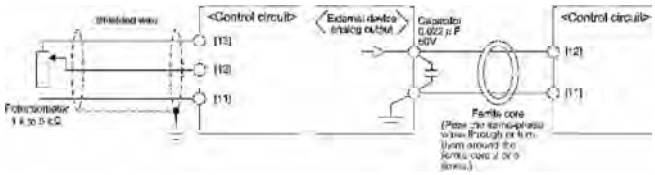
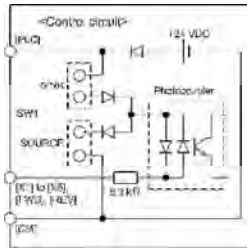


Figure 3.7 Connection of Shielded Wire

Figure 3.8 Example of Electric Noise Reduction

Classification	Symbol	Name	Functions
	[X1]	Digital input 1	(1) Various signals such as coast-to-stop, alarm from external equipment, and multi-frequency commands can be assigned to terminals [X1] to [X5], [FWD] and [REV] by setting function codes E01 to E05, E98, and E99. For details, refer to Chapter 6, Section 6.1 "Function codes tables". (2) Input mode, i.e. SINK/SOURCE, is changeable by using the internal slide switch. (Refer to Section 3.5, "Setting up the slide switches." (3) Switches the logic value (1/0) for ON/OFF of the terminals [X1] to [X5], [FWD], or [REV]. If the logic value for ON of the terminal [X1] is 1 in the normal logic system, for example, OFF is 1 in the negative logic system and vice versa. (4) The negative logic system never applies to the terminals assigned for ***FWD*** and ***REV***. (Digital input circuit specifications)  Figure 3.9 Digital Input Circuit
	[X2]	Digital input 2	
	[X3]	Digital input 3	
	[X4]	Digital input 4	
	[X5]	Digital input 5	
	[FWD]	Run forward command	
	[REV]	Run reverse command	

Item		Min.	Max.
Operation voltage (SINK)	ON level	0 V	2 V
	OFF level	22 V	27 V
Operation voltage (SOURCE)	ON level	22 V	27 V
	OFF level	0 V	2 V
Operation current at ON (Input voltage is at 0 V)		2.5 mA	5 mA
Allowable leakage current at OFF		-	0.5 mA

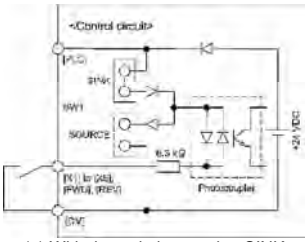
Classification	Symbol	Name	Functions
Digital input	[PLC]	PLC signal power	Connects to PLC output signal power supply. (Rated voltage: +24 VDC (Maximum 50 mA DC): Allowable range: +22 to +27 VDC) This terminal also supplies a power to the circuitry connected to the transistor output terminals [Y1] and [Y2]. Refer to "Analogue output, pulse output, transistor output, and relay output terminals" in this Section for more information.
	[CM]	Digital input common	Two common terminals for digital input signal terminals These terminals are electrically isolated from the terminals [11]s and [CMY].

Tip

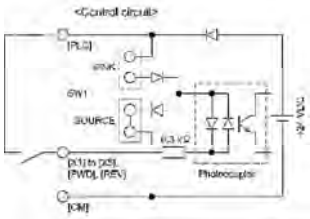
■ Using a relay contact to turn [X1], [X2], [X3], [X4], [X5], [FWD], or [REV] ON or OFF

Figure 3.10 shows two examples of a circuit that uses a relay contact to turn control signal input [X1], [X2], [X3], [X4], [X5], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch SW1 has been turned to SINK, whereas in circuit (b) it has been turned to SOURCE.

Note: To configure this kind of circuit, use a high quality relay.
(Recommended product: Fuji control relay Model HH54PW)



(a) With the switch turned to SINK



(b) With the switch turned to SOURCE

Figure 3.10 Circuit Configuration Using a Relay Contact

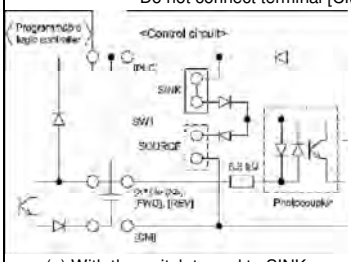
Tip

■ Using a programmable logic controller (PLC) to turn [X1], [X2], [X3], [X4], [X5], [FWD], or [REV] ON or OFF

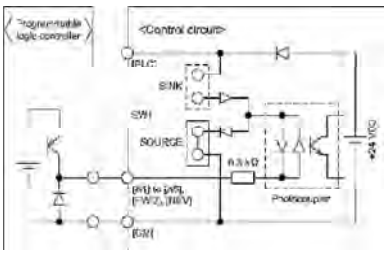
Figure 3.11 shows two examples of a circuit that uses a programmable logic controller (PLC) to turn control signal input [X1], [X2], [X3], [X4], [X5], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch SW1 has been turned to SINK, whereas in circuit (b) it has been turned to SOURCE.

In circuit (a) below, closing or opening the transistor's open collector circuit in the PLC using an external power supply turns ON or OFF control signal [X1], [X2], [X3], [X4], [X5], [FWD], or [REV]. When using this type of circuit, observe the following:

- Connect the + node of the external power supply (which should be isolated from the PLC's power) to terminal [PLC] of the inverter.
- Do not connect terminal [CM] of the inverter to the common terminal of the PLC.



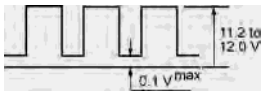
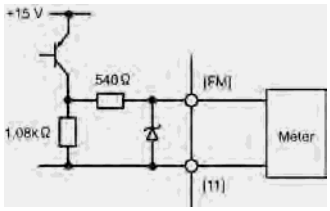
(a) With the switch turned to SINK



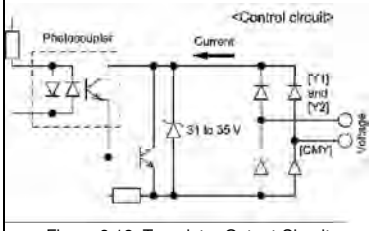
(b) With the switch turned to SOURCE

Figure 3.11 Circuit Configuration Using a PLC

For details about the slide switch setting, refer to Section 3.5, "Setting up the slide switches".

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="2">Analogue output</td><td rowspan="3">[FM]</td><td>Analogue monitor
(FMA function)</td><td>The monitor signal for analogue DC voltage (0 to +10 V) is output. You can select FMA function with slide switch SW6 on the interface PCB, and change the data of the function code F29.
You can also select the signal functions following with function code F31.
• Output frequency 1 (Before slip compensation)
• Output frequency 2 (After slip compensation)
• Output current • Output voltage • Output torque
• Load factor • Input power • PID feedback amount (PV)
• PG feedback value • DC link bus voltage • Universal AO
• Universal AO • Motor output • Calibration
• PID command (SV) • PID output (MV)
* Input impedance of external device: Min. 5kΩ (0 to +10 VDC output)
* While the terminal is outputting 0 to +10 VDC, it is capable to drive up to two meters with 10kΩ impedance. (Adjustable range of the gain: 0 to 300%)</td></tr>
<tr><td>Pulse monitor
(FMP function)</td><td>Pulse signal is output. You can select FMP function with the slide switch SW6 on the interface PCB, and change the data of the function code F29.
You can also select the signal functions following with function code F31.
* Input impedance of the external device: Min. 5kΩ
* Pulse duty: Approx. 50%
Pulse rate: 25 to 6000 p/s
<u>Voltage waveform</u>
• Pulse output waveform
 
• FM output circuit
  </td></tr>
<tr><td>Pulse output</td><td>[11]</td><td>Analogue common</td><td>Two common terminals for analogue input and output signal terminals
These terminals are electrically isolated from terminals [CM]s and [CMY].</td></tr>
</table>

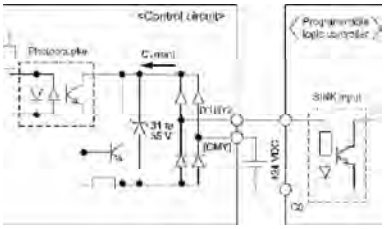
<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="3">Transistor output</td><td>[Y1]</td><td>Transistor output 1</td><td rowspan="2">(1) Various signals such as inverter running, speed/freq. arrival and overload early warning can be assigned to any terminals, [Y1] and [Y2] by setting function code E20 and E21. Refer to Chapter 6, Section 6.1 "Function codes tables" for details.
(2) Switches the logic value (1/0) for ON/OFF of the terminals between [Y1], [Y2], and [CMY]. If the logic value for ON between [Y1], [Y2], and [CMY] is 1 in the normal logic system, for example, OFF is 1 in the negative logic system and vice versa.

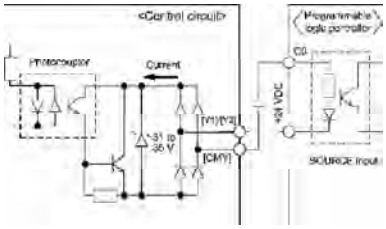
(Transistor output circuit specification)
 

<table>
<tr><th colspan="2">Item</th><th>Max.</th></tr>
<tr><td rowspan="2">Operation voltage</td><td>ON level</td><td>3 V</td></tr>
<tr><td>OFF level</td><td>27 V</td></tr>
<tr><td colspan="2">Maximum motor current at ON</td><td>50 mA</td></tr>
<tr><td colspan="2">Leakage current at OFF</td><td>0.1 mA</td></tr>
</table>
Figure 3.12 Transistor Output Circuit

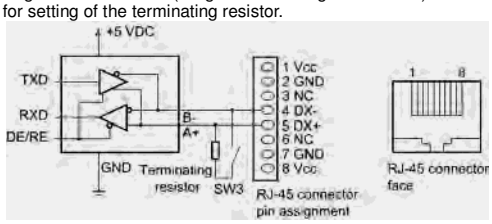
Figure 3.13 shows examples of connection between the control circuit and a PLC.

Note
• When a transistor output drives a control relay, connect a surge-absorbing diode across relay's coil terminals.
● When any equipment or device connected to the transistor output needs to be supplied with DC power, feed the power (+24 VDC: allowable range: +22 to +27 VDC, 50 mA max.) through the [PLC] terminal. Short-circuit between the terminals [CMY] and [CM] in this case.</td></tr>
<tr><td>[Y2]</td><td>Transistor output 2</td></tr>
<tr><td>[CMY]</td><td>Transistor output common</td><td>Common terminal for transistor output signal terminals
This terminal is electrically isolated from terminals, [CM]s and [11]s.</td></tr>
<tr><td colspan="4">Tip
■ Connecting Programmable Logic Controller (PLC) to Terminal [Y1] or [Y2]
Figure 3.13 shows two examples of circuit connection between the transistor output of the inverter's control circuit and a PLC. In example (a), the input circuit of the PLC serves as a SINK for the control circuit output, whereas in example (b), it serves as a SOURCE for the output.

(a) PLC serving as SINK
 

(b) PLC serving as SOURCE
Figure 3.13 Connecting PLC to Control Circuit</td></tr>
</table>

Classification	Symbol	Name	Functions
Relay output	[30A/B/C]	Alarm relay output (for any error)	(1) Outputs a contact signal (SPDT) when a protective function has been activated to stop the motor. Contact rating: 250 VAC, 0.3A, cos ϕ = 0.3, 48 VDC, 0.5A (2) Any one of output signals assigned to terminals [Y1] and [Y2] can also be assigned to this relay contact to use it for signal output. (3) Switching of the normal/negative logic output is applicable to the following two contact output modes: "Between terminals [30A] and [30C] is closed (excited) for ON signal output (Active ON)" or "Between terminals [30A] and [30C] is open (non-excited) for ON signal output (Active OFF).
Communication	RJ-45 connector for the keypad	Standard RJ-45 connector	(1) Used to connect the inverter with the keypad. The inverter supplies the power to the keypad through the pins specified below. The extension cable for remote operation also uses wires connected to these pins for supplying the keypad power. (2) Remove the keypad from the standard RJ-45 connector, and connect the RS-485 communications cable to control the inverter through the PC or PLC (Programmable Logic Controller). Refer to Section 3.5, "Setting up the slide switches" for setting of the terminating resistor.  Figure 3.14 RJ-45 Connector and its Pin Assignment* * Pins 1, 2, 7, and 8 are exclusively assigned to power lines for the standard keypad and multi-function keypad, so do not use those pins for any other equipment.

Note

- Route the wiring of the control circuit terminals as far from the wiring of the main circuit as possible. Otherwise electric noise may cause malfunctions.
- Fix the control circuit wires inside the inverter to keep them away from the live parts of the main circuit (such as the terminal block of the main circuit).
- The RJ-45 connector pin assignment on the FRENIC-Multi series is different from that on the FVR-E11S series. Do not connect to the keypad of the FVR-E11S series of inverter. Doing so could damage the internal control circuit.

Note

Mounting the interface printed circuit board (interface PCB)

- Usually, you do not need to remove the interface PCB. However, in the case you remove the interface PCB, be sure when reinstalling it to mount the interface PCB by locating the hooks provided on the interface PCB into the inverter until you hear a click.

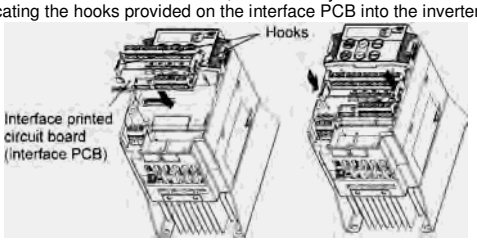
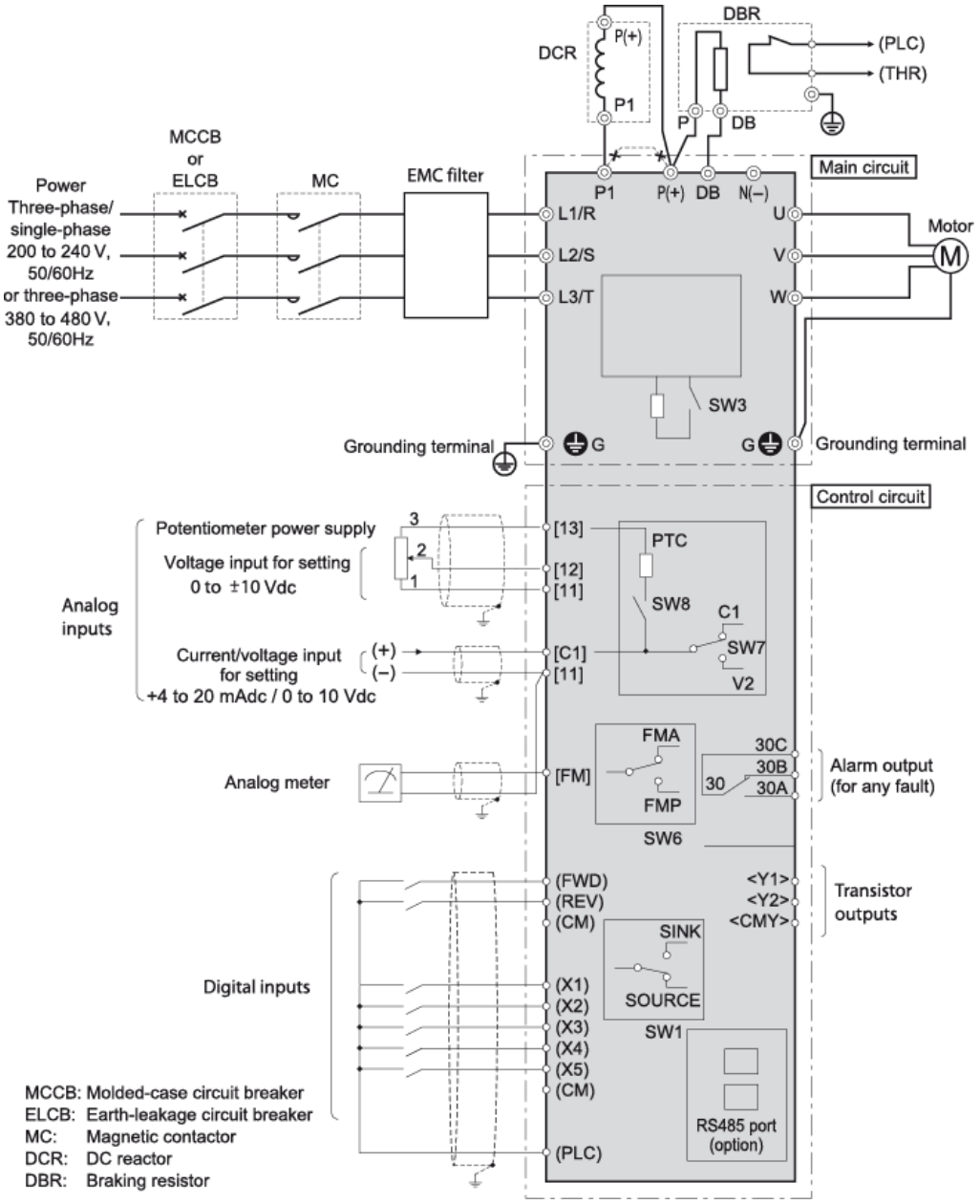


Figure 3.15 Mounting the Interface Printed Circuit Board (Interface PCB)

3.4 Connection diagram

The diagram below shows a basic connection example for running the inverter with terminal commands.



(Note 1) When connecting an optional DC reactor (DCR), remove the jumper bar from the terminals [P1] and [P (+)].

(Note 2) Install a recommended moulded-case circuit breaker (MCCB) or an earth-leakage circuit-breaker (ELCB) (with an overcurrent protection function) in the primary circuit of the inverter to protect wiring. At this time, ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

(Note 3) Install a magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or ELCB, when necessary.
Connect a surge killer in parallel when installing a coil such as the MC or solenoid near the inverter.

(Note 4) ***THR*** function can be used by assigning code "9" (external alarm) to any of the terminals [X1] to [X5], [FWD] and [REV] (function code: E01 to E05, E98, or E99).

(Note 5) Frequency can be set by connecting a frequency-setting device (external potentiometer) between the terminals [11], [12] and [13] instead of inputting a voltage signal (0 to +10 VDC, 0 to +5 VDC or +1 to +5 VDC) between the terminals [12] and [11].

(Note 6) For the control signal wires, use shielded or twisted pair wires. Ground the shielded wires. To prevent malfunction due to noise, keep the control circuit wiring away from the main circuit wiring as far as possible (recommended: 10 cm or more). Never install them in the same wire duct. When crossing the control circuit wiring with the main circuit wiring, ensure they are mounted perpendicular to ach other.

3.5 Setting up the slide switches

⚠WARNING

Before changing the switches, turn OFF the power and wait more than five minutes. Make sure that the LED monitor is turned OFF. Also, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P (+) and N (-) has dropped below the safe voltage (+25 VDC).

An electric shock may result if this warning is not heeded as there may be some residual electric charge in the DC bus capacitor even after the power has been turned off.

■ Setting up the slide switches

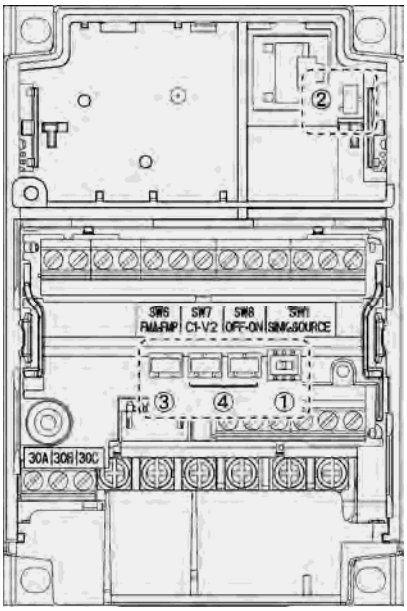
Switching the slide switches located on the control PCB and interface PCB allows you to customize the operation mode of the analogue output terminals, digital I/O terminals, and communications ports. The locations of those switches are shown in Figure 2.22.
To access the slide switches, remove the terminal cover and keypad. Table 3.3 lists function of each slide switch.

For details on how to remove the terminal cover, refer to Section 3.1, "Removing the terminal cover and main circuit terminal block cover."

Table 3.3 Function of Each Slide Switch

<table>
<tr><th>Slide Switch</th><th>Function</th></tr>
<tr><td>① SW1</td><td>Switches the service mode of the digital input terminals between SINK and SOURCE.
▪ To make the digital input terminal [X1] to [X5], [FWD] or [REV] serve as a current sink, turn SW1 to the SINK position. To make them serve as a current source, turn SW1 to the SOURCE position. Factory default: Source</td></tr>
<tr><td>② SW3</td><td>Switches the terminating resistor of RS-485 communications port on the inverter on and off.
▪ To connect a keypad to the inverter, turn SW3 to OFF. (Factory default)
▪ If the inverter is connected to the RS-485 communications network as a terminating device, turn SW3 to ON.</td></tr>
<tr><td>③ SW6</td><td>Switches the output mode of the output terminal [FM] between analogue voltage and pulse output.
When changing this switch setting, also change the data of function code F29.
<table>
<tr><th></th><th>SW6</th><th>Data for F29</th></tr>
<tr><td>Analogue voltage output (Factory default)</td><td>FMA</td><td>0</td></tr>
<tr><td>Pulse output</td><td>FMP</td><td>2</td></tr>
</table></td></tr>
<tr><td>④ SW7
SW8</td><td>Switches property of the input terminal [C1] for C1, V2, or PTC.
When changing this switch setting, also change the data of function code E59 and H26.
<table>
<tr><th></th><th>SW7</th><th>SW8</th><th>Data for E59</th><th>Data for H26</th></tr>
<tr><td>Analogue frequency setting in current (Factory default)</td><td>C1</td><td>OFF</td><td>0</td><td>0</td></tr>
<tr><td>Analogue frequency setting in voltage</td><td>V2</td><td>OFF</td><td>1</td><td>0</td></tr>
<tr><td>PTC thermistor input</td><td>C1</td><td>ON</td><td>0</td><td>1</td></tr>
</table></td></tr>
</table>

Figure 3.16 shows the location of slide switches for the input/output terminal configuration.



Switching example

② SW3

OFF	ON
OFF Factory default	ON

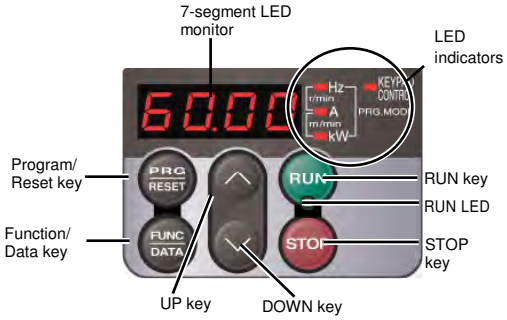
	③ SW6	④ SW7	④ SW8	① SW1
Factory default	FMA ←	C1 ←	OFF ←	SOURCE →
-	FMP →	V2 →	ON →	SINK ←

Figure 3.16 Location of the Slide Switches

4. OPERATION USING THE KEYPAD

As shown on the right, the keypad consists of a four-digit LED monitor, six keys, and five LED indicators.

The keypad allows you to run and stop the motor, monitor running status, and switch to the menu mode. In the menu mode, you can set the function code data, monitor I/O signal states, maintenance information, and alarm information.



Item	LED Monitor, Keys, and LED Indicators	Functions
LED Monitor	60.00	Four-digit, 7-segment LED monitor which displays the following according to the operation modes. ■ In Running mode: Running status information (e.g., output frequency, current, and voltage) ■ In Programming mode: Menus, function codes and their data ■ In Alarm mode: Alarm code, which identifies the alarm factor if the protective function is activated.
Operation Keys	PRG RESET	Program/Reset key which switches the operation modes of the inverter. ■ In Running mode: Pressing this key switches the inverter to Programming mode. ■ In Programming mode: Pressing this key switches the inverter to Running mode. ■ In Alarm mode: Pressing this key after removing the alarm factor will switch the inverter to Running mode.
	FUNC DATA	Function/Data key which switches the operation you want to do in each mode as follows: ■ In Running mode: Pressing this key switches the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A), output voltage (V), etc.). ■ In Programming mode: Pressing this key displays the function code and sets the data entered with ▲ and ▼ keys. ■ In Alarm mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor.
	RUN	RUN key. Press this key to run the motor.
	STOP	STOP key. Press this key to stop the motor.
	▲ and ▼	UP and DOWN keys. Press these keys to select the setting options and change the function code data displayed on the LED monitor.

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Indicators	RUN LED	Illuminates when any run command to the inverter is active.
	KEYPAD CONTROL LED	Illuminates when the inverter is ready to run with a run command entered by the RUN key (F02 = 0, 2, or 3). In Programming and Alarm modes, you cannot run the inverter even if the indicator lights.
	Unit and mode expression by the three LED indicators	The three LED indicators identify the unit of numeral displayed on the LED monitor in Running mode by combination of lit and unlit states of them. Unit: kW, A, Hz, r/min and m/min While the inverter is in Programming mode, the LEDs of Hz and kW illuminate. ■ Hz □ A ■ kW

Simultaneous keying

Simultaneous keying means pressing two keys at the same time. The FRENIC-Multi supports simultaneous keying as listed below. The simultaneous keying operation is expressed by a "+" letter between the keys throughout this manual.

(For example, the expression "STOP + ▲ keys" stands for pressing the ▲ key while holding down the STOP key.)

Operation mode	Simultaneous keying	Used to:
Programming mode	STOP + ▲ keys	Change certain function code data (Refer to codes F00, H03, and H97 in Chapter 6 "FUNCTION CODES").
	STOP + ▼ keys	
Alarm mode	STOP + PRG RESET keys	Switch to Programming mode without resetting alarms currently occurred.

FRENIC-Multi features the following three operation modes:

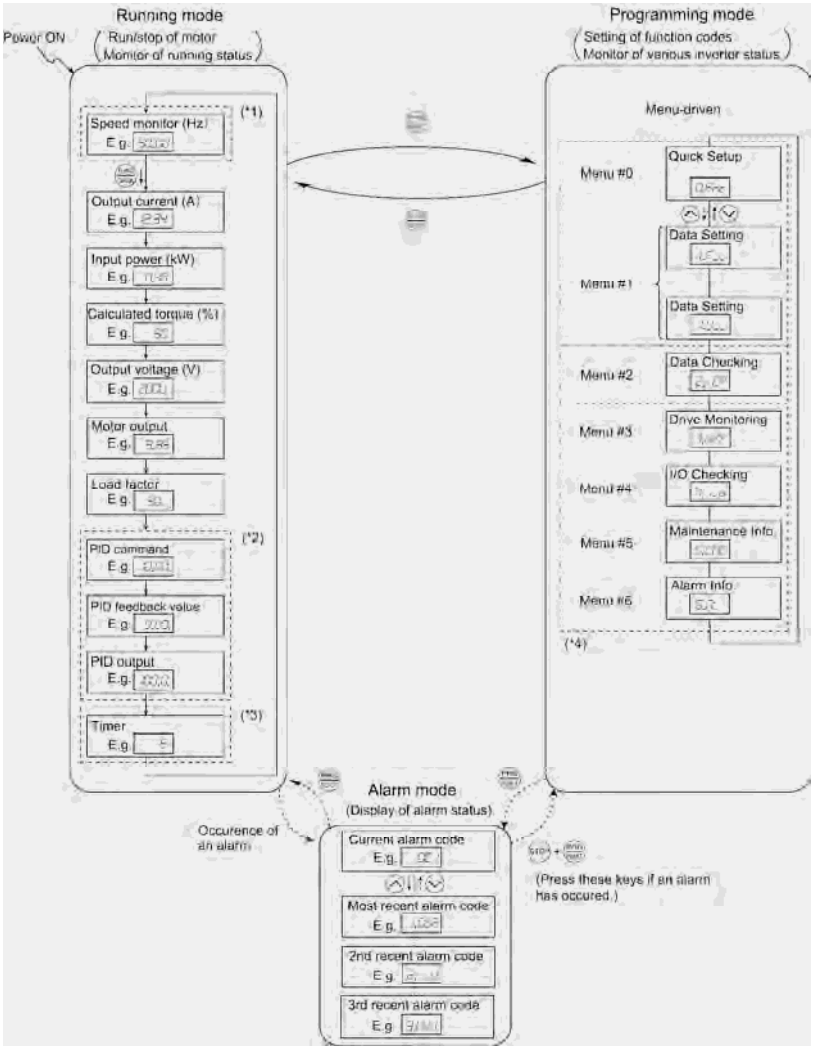
■ Running mode : This mode allows you to enter run/stop commands in regular operation. You can also monitor the running status in real time.

■ Programming mode : This mode allows you to configure function code data and check a variety of information relating to the inverter status and maintenance.

■ Alarm mode : If an alarm condition arises, the inverter automatically enters Alarm mode. In this mode, you can view the corresponding alarm code* and its related information on the LED monitor.

* Alarm code: Indicates the cause of the alarm condition that has triggered a protective function. For details, refer to Chapter 7, "TROUBLESHOOTING".

Figure 4.1 shows the status transition of the inverter between these three operation modes.



(*1) The speed monitor allows you to select the desired one from the seven speed monitor items by using function code E48.
(*2) Applicable only when PID control is active (J01 = 1, 2 or 3).
(*3) The Timer screen appears only when the timer operation is enabled with function code C21.
(*4) Applicable only when the full-menu mode is selected (E52 = 2).

Figure 4.1 Transition between Basic Screens in Individual Operation Mode

5. QUICK START COMMISION

5.1 Inspection and preparation prior to powering on

(1) Please check if the power wires are correctly connected to the inverter input terminals L1/R, L2/S and L3/T, if the motor is connected to the inverter terminals U, V and W and if the grounding wires are connected to the ground terminals correctly.

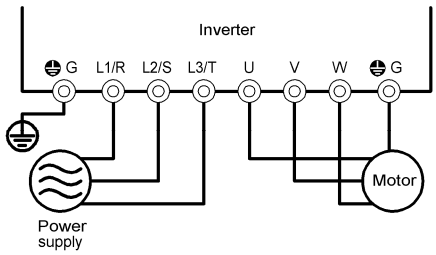
⚠WARNING

- Do not connect power supply wires to the inverter output terminals U, V, and W. Otherwise, the inverter may be damaged if you turn the power on.
- Be sure to connect the grounding wires of the inverter and the motor to the inverter ground terminals.

Otherwise an electric shock may occur

(2) Check for short circuits between terminals and exposed live parts and ground faults.
(3) Check for loose terminals, connectors and screws.
(4) Check if the motor is separated from mechanical equipment.
(5) Turn the switches off so that the inverter does not start or operate erroneously at power-on.
(6) Check if safety measures are taken against runaway of the system, e.g., a defense to protect people from unexpectedly approaching your power system.

Power circuit terminal wiring



5.2 Setting the function codes

Set the following function codes according to motor ratings and application values. For the motor, check the rated values printed on the nameplate of the motor.

Code	Name	Description
F 03	Maximum frequency	Motor characteristics
F 04	Base frequency	
F 05	Rated voltage	
F 07	Acceleration time 1	Application values
F 08	Deceleration time 1	
F 42	Control Mode Selection	
P 02	Motor rated capacity	Motor characteristics
P 03	Motor rated current	
P 12	Motor rated slip frequency	

5.3 Quick start commissioning (auto tuning)

It is recommended to perform the auto tuning procedure before running the motor for the first time. There are two auto tuning modes: auto tuning mode 1 (static) and auto tuning mode 2 (dynamic).

Auto tuning mode 1 (P04 = 1): Values of function codes P07 and P08 are measured.
Auto tuning mode 2 (P04 = 2): Values of function codes P07 and P08 are measured as well as the value of function code P06 (no load current) and the value of function code P12 (rated slip frequency). **When choosing this option, please remove the mechanical load from the motor.**

⚠WARNING
The motor will start moving if Auto tuning mode 2 (P04=2) is chosen

Auto tuning procedure

1. Power on the inverter.
2. Switch the operation mode from remote to local (setting F02 = 2 or 3).
3. If there are any kind of contactors between the motor and the inverter, please close them manually.
4. Set P04 to 1 (Auto tuning mode 1) or to 2 (Auto tuning mode 2), press FUNC/DATA and press RUN (the current flowing through the motor windings will generate a sound). The auto tuning takes a few seconds until it finishes by itself.
5. P07 and P08 will be measured (also P06 and P12 if Auto tuning mode 2 has been selected) and stored automatically in the inverter.
6. The auto tuning procedure has been finished.

LOCAL MODE TEST

1. Set F02 = 2 or F02 = 3 to select the local mode (RUN command given by the keypad).
2. Switch the inverter on and check the LED keypad is displaying and blinking *0.00* Hz.
3. Set a low frequency using the arrow keys ⌃ / ⌄ (check if the new frequency is already blinking in the LED keypad). Press PRG/RESET during one second to move the cursor across the LED keypad.
4. Press FUNC/DATA to store the new selected frequency.
5. Press RUN key to start driving the motor.
6. Press STOP key to stop the motor.

5.4 Operation

After confirming that the inverter can drive the motor, couple the motor to the machine and set up the necessary function codes for the application. Depending on the application conditions, further adjustments may be required such as acceleration and deceleration times, digital input/output functions. Make sure that the relevant function codes are set correctly.

6. FUNCTIONS CODES AND APPLICATION EXAMPLES

6.1 Function codes tables

Function codes enable the FRENIC-Multi series of inverters to be set up to match your system requirements.
The function codes are classified into nine groups: Fundamental Functions (F codes), Extension Terminal Functions (E codes), Control Functions of Frequency (C codes), Motor Parameters (P codes), High Performance Functions (H codes), Motor 2 Parameters (A codes), Application Functions (J codes), Link Function (y codes) and Option Functions (o codes).
For further information about the FRENIC-Multi function codes please refer to FRENIC-Multi user's manual.

F codes: Fundamental functions

Code	Name		Setting range	Default setting
F00	Data Protection		0: Disable data protection and Disable digital frequency ref. protection 1: Enable data protection and Disable digital frequency ref. protection 2: Disable data protection and Enable digital frequency ref. protection 3: Enable data protection and Enable digital frequency ref. protection	0
F01	Frequency Command 1		0: Enable arrow keys on the keypad 1: Enable voltage input to terminal [12] (-10 to 10V DC) 2: Enable current input to terminal [C1] (4 to 20 mA DC) 3: The sum of voltage and current inputs terminals [12] and [C1] 5: Enable voltage input to terminal [V2] (0 to 10V DC) 7: Enable terminal command (UP) / (DOWN) control 11: DI option card 12: PG/SY option card	0
F02	Operation Method		0: Enable RUN / STOP keys on the keypad (Motor rotational direction from digital terminals FWD/REV) 1: Enable terminal command FWD or REV 2: Enable RUN / STOP keys on keypad (forward) 3: Enable RUN / STOP keys on keypad (reverse)	2
F03	Maximum Frequency 1		25.0 to 400.0 Hz	50.0 Hz
F04	Base Frequency 1		25.0 to 400.0 Hz	50.0 Hz
F05	Rated Voltage at base Frequency 1		0: Output a voltage in proportion to input voltage 80 to 240V: Output a voltage AVR-controlled (200V AC series) 160 to 500V: Output a voltage AVR-controlled (400V AC series)	230V 400V
F06	Maximum Output Voltage 1		80 to 240V: Output a voltage AVR-controlled (200V AC series) 160 to 500V: Output a voltage AVR-controlled (400V AC series)	200V 400V
F07	Acceleration Time 1		0.00 to 3600 seconds; Note: Entering 0.00 cancels the acceleration time, requiring external soft-start	6.0
F08	Deceleration Time 1		0.00 to 3600 seconds; Note: Entering 0.00 cancels the deceleration time, requiring external soft-start	6.0
F09	Torque Boost 1		0.0 to 20.0 % (percentage of the rated voltage at base frequency (F05)). This setting is effective when F37 = 0,1,3 or 4	Depending on capacity
F10	Electronic Thermal Overload Protection for Motor	Select motor characteristics	1: For general-purpose motors with built-in-self-cooling fan 2: For inverter-driven motors or high-speed motors with forced-ventilation fan	1
F11		Overload detection level	0.0: Disable 1 to 135% of the rated current (allowable continuous drive current) of the motor	100 % of the motor rated current
F12		Thermal time constant	0.5 to 75.0 minutes	5.0
F14	Restart Mode after Momentary Power Failure	(Mode selection)	0: Disable restart (trip immediately) 1: Disable restart (trip after a recovery from power failure) 4: Enable restart (restart at the frequency at which the power failure occurred, for general loads) 5: Enable restart (restart at the starting frequency, for low-inertia load)	0
F15	Frequency limiter	High	0 to 400.0 Hz	70.0 Hz
F16		Low	0 to 400.0 Hz	0.0 Hz
F18	Bias (Frequency command 1)		-100.00 to 100.00 %	0.00 %
F20	DC Braking 1	Start freq.	0.0 to 60.0 Hz	0.0 Hz
F21		Braking level	0 to 100 %	0 %
F22		Braking time	0.00: Disable 0.01 to 30.0 s	0.00 s
F23	Starting Frequency 1		0.1 to 60.0 Hz	0.5 Hz
F24	(Holding time)		0.01 to 10.0 s	
F25	Stop Frequency		0.1 to 60.0 Hz	0.2 Hz
F26	Motor Sound	Carrier frequency	0.75 to 15 kHz	15 kHz
F27		Tone	0: Level 0 (Inactive) 1: Level 1 2: Level 2 3: Level 3	0

Code	Name		Setting range	Default setting
F29	Analogue output [FM]	Mode selection	0: Output in voltage (0 to 10V DC) [FMA] 1: Output in pulse (0 to 6000 p/s) [FMP]	0
F30		Voltage adjust.	0 to 300 % [FMA]	100 %
F31		Function	Select a function to be monitored from the followings. 0 : Output frequency1 (before slip compensation) 1 : Output frequency2 (after slip compensation) 2 : Output current 3 : Output voltage 4 : Output torque 5 : Load factor 6 : Input power 7 : PID feedback value (PV) 8 : PG feedback value 9 : DC link bus voltage 10 : Universal AO 13 : Motor output 14 : analog output (Calibration) 15 : PID process command (SV) 16 : PID process output (MV)	0
F33	Pulse Output [FM] (Pulse rate)		25 to 6000 p/s (Pulse rate at 100% output)	1440
F37	Load selection / Auto torque boost / Auto energy saving operation 1 Analogue		0 : Variable torque load 1 : Constant torque load 2 : Auto-torque boost 3 : Auto-energy saving operation (Variable torque load during ACC/DEC) 4 : Auto-energy saving operation (Constant torque load during ACC/DEC) 5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)	1
F39	Stop Frequency	Holding time	0.00 to 10.00 s	0.00
F40	Torque Limiter 1	(Limiting level for driving)	20 to 200 % 999 : Disable	999
F41		(Limiting level for braking)	20 to 200 % 999 : Disable	999
F42	Select Control Mode 1		0 : Disable (V/f control with slip compensation inactive) 1 : Enable (Dynamic torque vector control) 2 : Enable (V/f control with slip compensation active) 3 : Enable (V/f control with optional PG interface) 4 : Enable (Dynamic torque vector control with optional PG interface)	0
F43	Current Limiter	Mode selection	0: Disable (No current limiter works) 1: Enable at constant speed (Disabled during ACC/DEC) 2: Enable during acceleration and at constant operation	0
F44		Level	20 to 200 % (The data is interpreted as the rated output current of the inverter for 100%)	200 %
F50	Electronic Thermal Overload Protection for Braking Resistor	(Discharged capability)	1 to 900 kWs 999 : Disable 0: Reserved	999
F51		(Allowable average loss)	0.001 to 50.000 kW 0.000 : Reserved	0.000

E codes: Extension terminal functions

Code	Name	Data setting range		Default setting
E01	Terminal [X1]Function	Selecting function code data assigns the corresponding function to terminals [X1] to [X5] as listed below.		0
E02	Terminal [X2] Function			1
E03	Terminal [X3] Function			2
E04	Terminal [X4] Function			7
E05	Terminal [X5] Function	0 (1000): Select multistep frequency	[SS1]	8
		1 (1001): Select multistep frequency	[SS2]	
		2 (1002): Select multistep frequency	[SS4]	
		3 (1003): Select multistep frequency	[SS8]	
		4 (1004): Select ACC/DEC time	[RT2/RT1]	
		6 (1006): Enable 3-wire operation	[HLD]	
		7 (1007): Coast to stop	[BX]	
		8 (1008): Reset alarm	[RST]	
		9 (1009): Enable external alarm trip	[THR]	
		10 (1010): Ready for jogging	[JOG]	
		11 (1011): Switch frequency command 2/1	[Hz2/Hz1]	
		12 (1012): Select Motor2 / Motor1	[M2/M1]	
		13 : Enable DC braking	[DCBRK]	
		14 (1014): Select Torque Limiter Level	[TL2/TL1]	
		17 (1017): UP (Increase output frequency)	[UP]	
		18 (1018): DOWN (Decrease output frequency)	[DOWN]	
		19 (1019): Enable write from keypad (Data changeable)	[WE-KP]	
		20 (1020): Cancel PID control	[Hz/PID]	
		21 (1021): Switch normal/inverse operation	[IVS]	
		24 (1024): Enable communications link via RS485 or field bus (option)	[LE]	
		25 (1025): Universal DI	[U-DI]	
		26 (1026): Enable auto-search at starting	[STM]	
		27 (1027): Speed feedback control switch	[PG/HZ]	
		30 (1030): Force to stop	[STOP]	
		33 (1033): Reset PID integral and differential components	[PID-RST]	
		34 (1034): Hold PID integral component	[PID-HLD]	
		42 (1042): Position Control limit switch	[LS]	
		43 (1043): Position Control start/reset command	[S/R]	
		44 (1044): Switch to the serial pulse receiving mode	[SPRM]	
		45 (1045): Enter position control return mode	[RTN]	
		46 (1046): Overload stopping effective command	[OLS]	
		Setting the value of 1000s in parentheses () shown above assigns a negative logic input to a terminal. Note: In the case of THR a Stop, data (1009) and (1030) are for normal logic, and “9” and “30” are for negative logic, respectively.		
E10	Acceleration Time 2	0.00 to 3600 s Note: Entering 0.0 cancels the acceleration time, requiring external soft start		10.0
E11	Deceleration Time 2	0.00 to 3600 s Note: Entering 0.00 cancels the deceleration time, requiring external softstart.		10.0
E16	Torque Limiter 2 (Limiting level for driving)	20 to 200 % 999 : Disable		999
E17	(Limiting level for braking)	20 to 200 % 999 : Disable		999
E20	Terminal Y1 function	Selecting function code data assigns the corresponding function to terminals [Y1] to [Y2] and [30A/B/C] as listed below.		0
E21	Terminal Y2 function			7
E27	Terminal 30A/B/C function (Relay output)			99
		0 (1000): Inverter running	[RUN]	
		1 (1001): Frequency arrival signal	[FAR]	
		2 (1002): Frequency detected	[FDT]	
		3 (1003): Undervoltage detected (inverter stopped)	[LU]	
		4 (1004): Torque polarity detected	[B/D]	
		5 (1005): Inverter output limiting	[IOL]	
		6 (1006): Auto-restarting after momentary power failure	[IPF]	
		7 (1007): Motor overload early warning	[OL]	
		10 (1010): Inverter ready to run	[RDY]	
		21 (1021): Frequency arrival signal 2	[FAR2]	
		22 (1022): Inverter output limiting with delay	[IOL2]	
		26 (1026): Auto-resetting	[TRY]	
		27 (1027): Universal Digital Output	[U-DO]	
		28 (1028): Heat sink overheat early warning	[OH]	
		30 (1030): Service life alarm	[LIFE]	
		33 (1033): Command loss detected	[REF OFF]	
		35 (1035): Inverter output on	[RUN2]	
		36 (1036): Overload prevention control	[OLP]	
		37 (1037): Current detected	[ID]	
		38 (1038): Current detected 2	[ID2]	
		42 (1042): PID alarm	[PID-ALM]	
		49 (1049): Switched to motor 2	[SWM2]	
		57 (1057): Brake signal	[BRKS]	
		76 (1076): PG error signal	[PG-ERR]	
		80 (1080): Stop position override (Over Travelling)	[OT]	
		81 (1081): Indication of total elapsed time for one positioning cycle	[TO]	
		82 (1082): Completion of positioning	[PSET]	
		83 (1083): Current position pulse overflow	[POF]	
		99 (1099): Alarm output (for any alarm)	[ALM]	
		Setting the value of 1000s in parentheses () shown below assigns a negative logic input to a terminal.		

E29	Frequency arrival delay time		0.01 to 10.00 s	0.10
E30	Frequency Arrival	(Hysteresis width)	0.0 to 10.0 Hz	2.5
E31	Frequency detection (FDT)	Detection level	0.0 to 400.0 Hz	50
E32		Hysteresis Width	0.0 to 400.0 Hz	1.0
E34	Overload early warning/Current detection	Level	0.00: Disable Current value of 1% to 200% of the inverter rated current	100% of the motor rated current
E35		Timer	0.01 to 600.00 s	10.00 s
E37	Current Detection 2	Level	0.00: Disable Current value of 1 to 200% of the inverter rated current	100% of the motor rated current
E38		Timer	0.01 to 600.0 s	10.00 s
E39	Coefficient of Constant Feeding Rate Time		0.000 to 9.999 s	0.000
E40	PID display coefficient A		-999 to 0.00 to 9990	100
E41	PID display coefficient B		-999 to 0.00 to 9990	0.00
E42	LED display filter		0.0 to 5.0 s	0.5
E43	LED monitor	Item selection	0: Speed monitor (Select by E48) 3: Output current 4: Output voltage 8: Calculated torque 9: Input power 10: PID process command (Final) 12: PID feedback value 13: Timer 14: PID output 15: Load factor 16: Motor output 21: Current position pulse count (position control) 22: Position deviation pulse count (position control)	0
E45	LCD monitor (only with multi-functional keypad TP-G1)	Item selection	0: Running status, rotational direction and operation guide 1: Bar charts for output frequency, current and calculated torque	0
E46		Language selection	0: Japanese 1: English 2: Germany 3: French 4: Spanish 5: Italian	1
E47		Contrast control	0 (Low) to 10 (High)	5
E48	LED monitor	Speed monitor item	0: Output frequency (Before slip compensation) 1: Output frequency (After slip compensation) 2: Reference frequency 3: Motor speed in r/min 4: Load shaft in r/min 5: Line speed in m/min 6: Constant feeding rate time	0
E50	Coefficient for speed indication		0.01 to 200.00	30.00
E51	Display coefficient for input watt-hour data		0.000: (Cancel / reset) 0.001 to 9999	0.010
E52	Keypad (menu display mode)		0: Function code data editing mode (Menus #0 and #1) 1: Function code data check mode (Menus #2) 2: Full-menu mode (Menus #0 through #6)	0
E59	Terminal [C1] Signal Definition (C1/V2 Function)		0 : Current input (C1 function), 4 to 20 mA DC) 1: Voltage input (V2 function), 0 to +10V DC)	0
E61	Analogue input for (Extension function selection)	[12]	Selecting function code data assigns the corresponding function to terminals [12], [C1] and [V2] as listed below 0: None 1: Auxiliary frequency command 1 2: Auxiliary frequency command 2 3: PID process command 1 5: PID feedback value	0
E62		[C1]		0
E63		[V2]		0
E65	Reference Loss Detection (Continuous running frequency)		0: Decelerate to stop 20 to 120 % 999: Disable	999

E98 E99	Terminal [FWD] Function Terminal [REV] Function	Selecting function code data assigns the corresponding function to terminals [FWD] and [REV] as listed below.		98
		0 (1000): Select multistep frequency	[SS1]	
		1 (1001): Select multistep frequency	[SS2]	
		2 (1002): Select multistep frequency	[SS4]	
		3 (1003): Select multistep frequency	[SS8]	
		4 (1004): Select ACC/DEC time	[RT2/RT1]	
		6 (1006): Enable 3-wire operation	[HLD]	
		7 (1007): Coast to stop	[BX]	
		8 (1008): Reset alarm	[RST]	
		9 (1009): Enable external alarm trip	[THR]	
		10 (1010): Ready for jogging	[JOG]	
		11 (1011): Switch frequency command 2/1	[Hz2/Hz1]	
		12 (1012): Select Motor 2 / Motor1	[M2/M1]	
		13 : Enable DC braking	[DCBRK]	
		14: (1014): Select Torque Limiter Level	[TL2/TL1]	
		17 (1017): UP (Increase output frequency)	[UP]	
		18 (1018): DOWN (Decrease output frequency)	[DOWN]	
		19 (1019): Enable write from keypad (Data changeable)	[WE-KP]	
		20 (1020): Cancel PID control	[Hz/PID]	99
		21 (1021): Switch normal/inverse operation	[IVS]	
		24 (1024): Enable communications link via RS485 or field bus (option)	[LE]	
		25 (1025): Universal DI	[U-DI]	
		26 (1026): Enable auto-search at starting	[STM]	
		27 (1027): Speed feedback control switch	[PG/HZ]	
		30 (1030): Force to stop	[STOP]	
		33 (1033): Reset PID integral and differential components	[PID-RST]	
		34 (1034): Hold PID integral component	[PID-HLD]	
		42 (1042): Position Control limit switch	[LS]	
		43 (1043): Position Control start/reset command	[S/R]	
		44 (1044): Switch to the serial pulse receiving mode	[SPRM]	
		45 (1045): Enter position control return mode	[RTN]	
		46 (1046): Overload stopping effective command	[OLS]	
		98 : RUN forward	[FWD]	
		99 : RUN reverse	[REV]	
		Setting the value of 1000s in parentheses () shown below assigns a negative logic input to a terminal. Note: In the case of THR a Stop, data (1009) and (1030) are for normal logic, and “9” and “30” are for negative logic, respectively.		

C codes: Control functions of frequency

Code	Name		Data setting range	Default setting
C01	Jump frequency	1	0.0 to 400.0 Hz	0.0
C02		2		0.0
C03		3		0.0
C04		Hysteresis width	0.0 to 30.0 Hz	3.0
C05	Multistep frequency	1	0.00 to 400.00 Hz	0.00
C06		2		0.00
C07		3		0.00
C08		4		0.00
C09		5		0.00
C10		6		0.00
C11		7		0.00
C12		8		0.00
C13		9		0.00
C14		10		0.00
C15		11		0.00
C16		12		0.00
C17		13		0.00
C18		14		0.00
C19		15		0.00
C20	Jogging Frequency		0.00 to 400.00 Hz	0.00
C21	Timer Operation	Mode Selection	0 : Disable 1 : Enable	0
C30	Frequency command 2		0 : Enable arrow keys on the keypad 1 : Enable voltage input to terminal [12] (-10 to 10V DC) 2 : Enable current input to terminal [C1] (4 to 20 mA) 3 : The sum of voltage and current inputs terminals [12] and [C1] 5 : Enable voltage input to terminal [V2] (0 to 10V DC) 7 : Enable terminal command (UP) / (DOWN) control 11 : DI interface card (option) 12 : PG / SY interface card (option)	2
C31	Analogue input adjustment for [12]	Offset	-5.0 to 5.0 %	0.0
C32		Gain	0.00 to 200.00 %	100.0 %
C33		Filter time constant	0.00 to 5.00 s	0.05
C34		Gain base point	0.00 to 100.00 %	100.0 %
C35		Polarity	0 : Bipolar 1 : Unipolar	1
C36	Analogue input adjustment for [C1]	Offset	-5.0 to 5.0 %	0.0
C37		Gain	0.00 to 200.00 %	100.0
C38		Filter time constant	0.00 to 5.00 s	0.05
C39		Gain base point	0.00 to 100.00 %	100.0
C41	Analogue input adjustment for [V2]	Offset	-5.0 to 5.0 %	0.0
C42		Gain	0.00 to 200.00 %	100.0
C43		Filter time constant	0.00 to 5.00 s	0.05
C44		Gain base point	0.00 to 100.00 %	100.0
C50	Bias base point (Frequency command 1)	Bias base point	0.00 to 100.00 %	0.00
C51	Bias for PID command	Bias value	-100.00 to 100.00 %	0.00
C52		Bias reference point	0.00 to 100.00 %	0.00
C53	Selection of normal/inverse operation (Frequency command 1)		0: Normal operation 1: Inverse operation	0

P codes: Motor parameters

Code	Name		Data setting range	Default setting
P01	Motor	No. of poles	2 to 22	4
P02		Rated capacity	0.01 to 30.00 kW (where P99 is 0, 3 or 4) 0.01 to 30.00 HP (where P99 is 1)	Rated capacity of the motor
P03		Rated current	0.00 to 100.0 A	Rated current of Fuji standard motor
P04		Auto-tuning	0: Disable 1: Enable (Tune %R1 and %X while the motor is stopped) 2: Enable (Tune %R1 and %X while the motor is stopped and no-load current while running)	0
P05		Online Tuning	0 : Disable 1 : Enable	0
P06		No-load current	0.00 to 50.00 A	Rated value of Fuji standard motor
P07		%R1	0.00 to 50.00 %	
P08		%X	0.00 to 50.00 %	
P09		Slip compensation gain for driving	0.0 to 200.0 %	100.0
P10		Slip compensation response time	0.01 to 10.00 s	0.50
P11		Slip compensation gain for braking	0.0 to 200.0 %	100.0
P12		Rated slip frequency	0.00 to 15.00 Hz	Rated value of Fuji standard motor
P99		Motor selection	0: Characteristics of motor 0 (Fuji standard motors, 8-series) 1: Characteristics of motor 1 (HP-rated motors) 3: Characteristics of motor 3 (Fuji standard motors, 6-series) 4: Other motors	0

H codes: High performance functions

Code	Name		Data setting range		Default setting
H03	Data initialization		0: Disable initialization 1: Initialize all function code data to the factory defaults 2: Initialize motor parameters (motor 1) 3: Initialize motor parameters (motor 2)		0
H04	Auto-resetting	Times	0: Disable 1 to 10		0
H05		Reset interval	0.5 to 20.0 s		5.0
H06	Cooling fan ON/OFF control		0: Disable (Always in operation) 1: Enable (ON/OFF controllable)		0
H07	Acceleration/Deceleration pattern		0: Linear 1: S-curve (Weak) 2: S-curve (Strong) 3: Curvilinear		0
H08	Rotational Direction Limitation		0 : Disable 1 : Enable (Reverse rotation inhibited) 2 : Enable (Forward rotation inhibited)		0
H09	Select starting characteristics (Auto search)		0 : Disable 1 : Enable (At restart after momentary power failure) 2 : Enable (At restart after momentary power failure and at normal start)		0
H11	Deceleration mode		0: Normal deceleration 1: Coast-to-stop		0
H12	Instantaneous overcurrent limiting		0: Disable 1: Enable		1
H13	Restart mode after momentary power failure	Restart time	0.1 to 10.0 s		Depending on the inverter capacity
H14		Frequency fall rate	0.00: Selected deceleration time 0.01 to 100.0 Hz/s 999: Follow the current limit command		999
H16		Allowable momentary power failure time	0.0 to 30.0 s 999: The longest time automatically determined by the inverter		999
H26	PTC Thermistor	Mode selection	0: Disable 1: Enable (Upon detection of PTC, the inverter immediately trips and stops with OH4 displayed)		0
H27		Level	0.00 to 5.00 V		1.60
H28	Droop Control		-60.0 to 0.0 Hz		0.0
H30	Communication link function (Mode selection)		Frequency command 0: F01/C30 1: RS485 link 2: F01/C30 3: RS485 link 4: RS485 link (option) 5: RS485 link (option) 6: F01/C30 7: RS485 link 8: RS485 link (option)	RUN command F02 F02 RS485 RS485 F02 RS485 link RS485 link (option) RS485 link (option) RS485 link (option)	0

Code	Name		Data setting range	Default setting
H42	Capacitance of DC link bus capacitor		Indication for replacing DC link bus capacitor (0000 to FFFF: Hexadecimal)	-
H43	Cumulative run time of cooling fan		Indication of cumulative run time of cooling fan for replacement	-
H44	Startup Times of Motor 1		Indication of cumulative startup times	-
H45	Mock Alarm		0: Disable 1: Enable (Once a mock alarm occurs, the data automatically returns to 0)	0
H47	Initial capacitance of DC link bus capacitor		Indication for replacing DC link bus capacitor (0000 to FFFF: Hexadecimal)	Set at factory shipping
H48	Cumulative Run Time of Capacitors on the Printed Circuit Board		Indication for replacing capacitors on the printed circuit board (0000 to FFFF: Hexadecimal). Reset able	-
H49	Starting mode (Delay Time)		0.0 to 10.0 s	0.0
H50	Non-linear V/f pattern	Frequency	0.0: Cancel 0.1 to 400.0 Hz	0.0
H51		Voltage	0 to 240V: Output a voltage AVR-controlled (for 200V AC series) 0 to 500V: Output a voltage AVR-controlled (for 400V AC series)	0
H52	Non-linear V/f Pattern 2	Frequency	0.0: Cancel 0.1 to 400.0 Hz	0
H53		Voltage	0 to 240V: Output a voltage AVR-controlled (for 200V AC series) 0 to 500V: Output a voltage AVR-controlled (for 400V AC series)	0
H54	ACC/DEC time	Jogging operation	0.00 to 3600 s	6.0
H56	Deceleration time for forced stop		0.00 to 3600 s	6.0
H61	UP/DOWN Control (Initial frequency setting)		0: 0.0 1: Last UP/DOWN cammand value on releasing run command	1
H63	Low limiter	Mode selection	0: Limit by F16 (Frequency Limiter: Low) and continue to run 1: If the output frequency lowers less than the one limited by F16 (Frequency limiter: Low), decelerates to stop the motor	0
H64		Lower limiting frequency	0.0 (Depends on F16 (Frequency limiter: Low) 0.1 to 60.0 Hz	1.6
H68	Slip Compensation	(Operating conditions)	0: Enable during ACC/DEC and enable at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and disable at base frequency or above	0
H69	Automatic deceleration	(Mode selection)	0: Disable 2: Enable (Canceled if actual deceleration time exceeds three times the one specified by F08/E11) 4: Enable (Not canceled if actual deceleration time exceeds three times the one specified by F08/E11)	0
H70	Overload Prevention Control		0.00: Follow deceleration time specified by F08 / E11 0.01 to 100.00 Hz/s 999: Disable	999
H71	Deceleration characteristics		0: Disable 1: Enable	0
H76	Torque Limiter (Frequency increment limit for braking)		0.0 to 400.0 Hz	5.0
H80	Output Current Fluctuation Damping Gain for Motor 1		0.00 to 0.40	0.20
H89	Reserved			
H90	Reserved			
H91	Reserved			
H94	Cumulative run time of motor		Change or reset the cumulative data	-
H95	DC braking (braking response mode)		0: Slow 1: Quick	1
H96	STOP key priority/start check function		STOP key priority / Start check function 0: Disable / Disable 1: Enable / Disable 2: Disable / Enable 3: Enable / Enable	0
H97	Clear alarm data		0: Does not clear alarm data 1: Clear alarm data and return to zero	0
H98	Protection/maintenance Function (Mode selection)		0 to 31: Display data on the keypad's LED monitor in decimal format (In each bit, "0" for disabled, "1" for enabled) Bit 0: Lower the carrier frequency automatically Bit 1: Detect input phase loss Bit 2: Detect output phase loss Bit 3: Select life judgment criteria of DC link bus capacitor Bit 4: Judge the life of DC link bus capacitor	19 (Bits 4,1,0 = 1)

A codes: Motor 2 Parameters

Code	Name		Data setting range	Default setting
A01	Maximum Frequency 2		25 to 400.0 Hz	50.0
A02	Base Frequency 2		25 to 400.0 Hz	50.0
A03	Rated Voltage at Base Frequency 2		0: Output a voltage in proportion to input voltage 80 to 240: Output an AVR-controlled (for 200V class series) 160 to 500: Output an AVR-controlled (for 400V class series)	230 400
A04	Maximum Output Voltage 2		80 to 240V: Output an AVR-controlled (for 200V class series) 160 to 500V: Output an AVR-controlled (for400V class series)	200 400
A05	Torque Boost 2		0.0 to 20.0 % (percentage with respect to "A03: Rated Voltage at Base Frequency 2") Note: This setting takes effect when A13 = 0, 1, 3 or 4.	Depending on the inverter capacity
A06	Electronic Thermal Overload Protection for Motor 2 (Select motor Characteristics)		1: general-purpose motor with shaft driven cooling fan 2: For an inverter-driven motor, non ventilated motor, or motor with separately powered fan	1
A07	(Overload detection level)		0.00 : Disable 1 to 135% of the rated current (allowable continuous drive current) of the motor	100% of the motor rated current
A08	(Thermal time constant)		0.5 to 75.0 min	5.0
A09	DC Braking 2 (Braking starting frequency)		0.0 to 60.0 Hz	0.0
A10	(Braking level)		0 to 100%	0
A11	(Braking time)		0.00 : Disable 0.01 to 30.00 s	0.00
A12	Starting Frequency 2		0.01 to 60.0 Hz	0.05
A13	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation 2		0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy saving operation (Variable torque during ACC/DEC) 4: Auto energy saving operation (Constant torque during ACC/DEC) 5: Auto energy saving operation (Auto-torque boost during ACC/DEC)	1
A14	Control Mode Selection 2		0: V/f operation with slip compensation inactive 1: Dynamic torque vector operation 2: V/f operation with slip compensation active 3: V/f operation with optional PG interface 4: Dynamic torque vector operation with optional PG interface	0
A15	Motor2	(No. of poles)	2 to 22	4
A16		(Rated capacity)	0.01 to 30.00 kW (where A39 data is 0, 3 or 4) 0.01 to 30.00 HP (where A39 data is 1)	Rated capacity of motor
A17		(Rated current)	0.00 to 100.0 A	Rated value of Fuji standard motor
A18		(Auto Tuning)	0: Disable 1: Enable (Tune %R1 and %X while motor is stopped) 2: Enable (Tune %R1 and %X while motor is stopped and no load current while running)	0
A19		(Online Tuning)	0: Disable 1: Enable	0
A20		(No load current)	0.00 to 50.00 A	Rated value of Fuji standard motor
A21		(%R1)	0.00 to 50.00 %	Rated value of Fuji standard motor
A22		(%X)	0.00 to 50.00 %	Rated value of Fuji standard motor
A23		(Slip compensation gain for driving)	0.0 to 200.0 %	100.0
A24		(Slip compensation response time)	0.01 to 10.00 s	0.50
A25		(Slip compensation gain for braking)	0.0 to 200.0 %	100.0
A26		(Rated slip frequency)	0.00 to 15.0 Hz	Rated value of Fuji standard motor
A39	Motor 2 Selection		0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 3: Motor characteristics 3 (Fuji standard motors, 6 series) 4: Other motors	0
A40	Slip Compensation 2 (Operating conditions)		0: Enable during ACC/DEC and enable at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and disable at base frequency or above	0
A41	Output Current Fluctuation Damping Gain for Motor 2		0.00 to 0.40	0.20
A45	Cumulative Motor Run Time 2		Change or reset the cumulative data	-
A46	Startup Times of Motor 2		Indication of cumulative startup times	-

J codes: Application functions

Code	Name		Data setting range	Default setting
J01	PID control	Mode selection	0: Disable 1: Enable (Process control, normal operation) 2: Enable (Process control, inverse operation) 3: Enable (Dancer control)	0
J02		Remote process command SV	0: Enable arrow keys on keypad 1: PID process command 1 3: Enable terminal command UP/DOWN control 4: Command via communications link	0
J03		P (Gain)	0.000 to 30.000	0.100
J04		I (Integration time)	0.0 to 3600.0 s	0.0
J05		D (Differential time)	0.00 to 600.0 s	0.00
J06		Feedback filter	0.0 to 900.0 s	0.5
J10		Anti reset windup	0 to 200 %	200
J11		Select alarm output	0: Absolute-value alarm 1: Absolute-value alarm (with Hold) 2: Absolute-value alarm (with Latch) 3: Absolute-value alarm (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (with Hold) 6: Deviation alarm (with Latch) 7: Deviation alarm (with Hold and Latch)	0
J12		Upper limit alarm (AH)	-100 % to 100 %	100
J13		Lower limit alarm (AL)	-100 % to 100 %	0
J18		Upper limit of PID process output	-150 % to 150 % 999: Depends on setting of F15	999
J19		Lower limit of PID process output	-150 % to 150 % 999: Depends on setting of F16	999
J56		(Speed command filter)	0.00 to 5.00 s	0.10
J57		(Dancer reference position)	-100 % to 100 %	0
J58		(Detection width of dancer position deviation)	0: Disable switching PID constant 1 % to 100 %	0
J59		P (Gain) 2	0.000 to 30.00	0.100
J60		I (Integral time) 2	0.0 to 3600.0 s	0.0
J61		D (Differential time) 2	0.00 to 600.0 s	0.0
J62		(PID control block selection)	Bit 0: PID output pole 0 = addition, 1 = substraction Bit 1: PID Select compensation of output ratio 0 = Speed command, 1 = ratio	0
J63	Overload Stop	(Detection value)	0: Torque 1: Current	0
J64		(Detection Level)	20 to 200 %	100
J65		(Mode selection)	0: Disable 1: Decelerate to stop 2: Coast to a stop 3: Hit mechanical stop	0
J66		(Operation condition)	0: Enable at constant speed and during deceleration 1: Enable at constant speed 2: Enable anytime	0
J67		(Timer)	0.00 to 600.00 s	0
J68	Braking Signal	(Brake OFF current)	0 to 200 %	100
J69		(Brake OFF frequency)	0.0 to 25.0 Hz	1.0
J70		(Brake OFF timer)	0.0 to 5.0 s	1.0
J71		(Brake ON frequency)	0.0 to 25.0 Hz	1.0
J72		(Brake ON timer)	0.0 to 5.0 s	1.0
J73	Position control	(Start timer)	0.0 to 1000.0 s	0.0
J74		(Start point MSD)	-999 to 999 p	0
J75		(Start point LSD)	[P], 0 to 9999 p	0
J76		(Preset position MSD)	-999 to 999	0
J77		(Preset position LSD)	[P], 0 to 9999 p	0
J78		(Creep speed switch point MSD)	0 to 999 p	0
J79		(Creep speed switch point LSD)	0 to 9999 p	0
J80		(Creep speed)	0 to 400Hz	0
J81		(End position MSD)	-999 to 999 p	0
J82		(End position LSD)	0 to 9999 p	0
J83		(Completion width)	0 to 9999 p	0
J84		(End timer)	0.0 to 1000.0 s	0
J85		(Coasting compensation)	0.0 to 9999 p	0
J86		(Stopping position specifying method)	0: B phase pulse input 1: Pulse input with polarity	0
J87		(Position pre-set condition)	0: Forward rotation direction 1: Reverse rotation direction 2: Both forward / reverse rotation direction	0
J88		(Position detecting direction)	0: Forward direction 1: Invert the current direction (x -1)	0
J90	Overload stopping Function	torque limit P (Gain)	0.000 to 2.000, 999	999
J91		torque limit I (Integral time)	0.001 to 9.999 s, 999	999
J92		Current control level	50.0 to 150.0 %	100.0

Y codes: Link functions

Code	Name		Data setting range	Default setting
Y01	RS485 communication (standard)	(Station address)	1 to 255	1
Y02		Communications error (processing)	0: Immediately trip with alarm Er8 1: Trip with alarm Er8 after running for the period specified by timer y03 2: Retry during the period specified by timer y03. If retry fails, trip and alarm Er8. If it succeeds, continue to run 3: Continue to run	0
Y03		(Timer)	0.0 to 60.0 s	2.0
Y04		(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	3
Y05		(Data length)	0: 8 bits 1: 7 bits	0
Y06		(Parity check)	0: None (2 stop bits for Modbus RTU) 1: Even parity (1 stop bit for Modbus RTU) 2: Odd parity (1 stop bit for Modbus RTU) 3: None (1 stop bit for Modbus RTU)	0
Y07		(Stop bits)	0: 2 bits 1: 1 bit	0
Y08		(No-response error detection time)	0 : No detection 1 to 60 s	0
Y09		(Response latency time)	0.00 to 1.00 s	0.01 seconds
Y10		(Protocol selection)	0: Modbus RTU protocol 1: FRENIC Loader protocol (SX protocol) 2: Fuji general-purpose inverter protocol	1
Y11	RS485 communication (option)	(Station address)	1 to 255	1
Y12		(Communications error processing)	0: Immediately trip with alarm ErP 1: Trip with alarm ErP after running for the period specified by timer y13 2: Retry during the period specified by timer y13. If retry fails, trip and alarm ErP. If it succeeds, continue to run 3: Continue to run	0
Y13		Error processing(Timer)	0.0 to 60.0 s	2.0
Y14		Transmission speed(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	3
Y15		Data length	0: 8 bits 1: 7 bits	0
Y16		(Parity check)	0: None (2 stop bit for Modbus RTU) 1: Even parity (1 stop bit for Modbus RTU) 2: Odd parity (1 stop bit for Modbus RTU) 3: None (1 stop bit for Modbus RTU)	0
Y17		(Stop bits)	0: 2 bits 1: 1 bit	0
Y18		(No-response error detection time)	0 : No detection 1 to 60 s	0
Y19		(Response latency time)	0.00 to 1.00 s	0.01 seconds
Y20		(Protocol selection)	0: Modbus RTU protocol 2: Fuji general-purpose inverter protocol	0
Y98	Bus Link Function	(Mode selection)	Frequency command / Run command 0: Follow H30 and Y98 data / Follow H30 data 1: Via field bus option / Follow H30 data 2: Follow H30 data / Via field bus option 3: Via field bus option / Via field bus option	0
Y99	Loader Link Function	(Mode selection)	Frequency command / Run command 0: Follow H30 and Y98 data / Follow H30 data and y98 data 1: Via RS-485 link (Loader) / Follow H30 data and y98 data 2: Follow H30 data and y98 data / Via RS-485 link (Loader) 3: Via RS-485 link (Loader) / Via RS-485 link (Loader)	0

o codes: Option functions

Code	Name	Data setting range	Default setting
o01	Command / feedback input (Input from selection)	0, 1, 2, 10, 11, 12, 20 ,21 ,22	0
o02	Speed control (P Item)	0.01 to 200.00	10.00
o03	(I Item)	0.000 to 5.000 s	0.100
o04	(Filter time constant)	0.000 to 5000 s	0.020
o05	(Pulse line input) (Encoder pulse number)	20 to 3600 P/R	1024
o06	(Filter time constant)	0.000 to 5.000 s	0.005
o07	(Pulse compensation coefficient 1)	1 to 9999	1
o08	(Pulse compensation coefficient 2)	1 to 9999	1
o09	Feedback (Feedback input) (Encoder pulse number)	20 to 3600 P/R	1024
o10	(Filter time constant)	0.000 to 5.000 s	0.005
o11	(Pulse compensation coefficient 1)	1 to 9999	1
o12	(Pulse compensation coefficient 2)	1 to 9999	1
o13	Speed control (Output limiter)	0.00 to 100.0 %	100.00
o14	Reserved		
o15	Reserved		
o16	Reserved		
o17	Excessive speed deviation (Level)	0 to 50 %	10
o18	(Timer)	0.0 to 10.0 s	0.5
o19	PG abnormal error selection	0, 1, 2	2
o20	DIO option (DI mode selection)	0: 8 bit binary setting 1: 12 bit binary setting 4: BCD 3-digit setting 0 to 99.9 5: BCD 3-digit setting 0 to 999	0
o21	(DO mode selection)	0: Output frequency (before slip compensation) 1: Output frequency (after slip compensation) 2: Output current 3: Output voltage 4: Output torque 5: Overload rate 6: Power consumption 7: PID feedback amount 9: DC link voltage 13: Motor output 15: PID command (SV) 16: PID command (MV) 99: Individual signal output	0
o27	Transmission Error (Operation selection)	0 to 15	0
o28	(Timer selection)	0.0 to 60.0 s	0.0
o30	Bus setting parameter 1	0 to 255	0
o31	Bus setting parameter 2	0 to 255	0
o32	Bus setting parameter 3	0 to 255	0
o33	Bus setting parameter 4	0 to 255	0
o34	Bus setting parameter 5	0 to 255	0
o35	Bus setting parameter 6	0 to 255	0
o36	Bus setting parameter 7	0 to 255	0
o37	Bus setting parameter 8	0 to 255	0
o38	Bus setting parameter 9	0 to 255	0
o39	Bus setting parameter 10	0 to 255	0
o40	Writing function code allocation 1	0000H to FFFFH	0000H
o41	Writing function code allocation 2	0000H to FFFFH	0000H
o42	Writing function code allocation 3	0000H to FFFFH	0000H
o43	Writing function code allocation 4	0000H to FFFFH	0000H
o44	Writing function code allocation 5	0000H to FFFFH	0000H
o45	Writing function code allocation 6	0000H to FFFFH	0000H
o46	Writing function code allocation 7	0000H to FFFFH	0000H
o47	Writing function code allocation 8	0000H to FFFFH	0000H
o48	Read function code allocation 1	0000H to FFFFH	0000H
o49	Read function code allocation 2	0000H to FFFFH	0000H
o50	Read function code allocation 3	0000H to FFFFH	0000H
o51	Read function code allocation 4	0000H to FFFFH	0000H
o52	Read function code allocation 5	0000H to FFFFH	0000H
o53	Read function code allocation 6	0000H to FFFFH	0000H
o54	Read function code allocation 7	0000H to FFFFH	0000H
o55	Read function code allocation 8	0000H to FFFFH	0000H
o56	Read function code allocation 9	0000H to FFFFH	0000H
o57	Read function code allocation 10	0000H to FFFFH	0000H
o58	Read function code allocation 11	0000H to FFFFH	0000H
o59	Read function code allocation 12	0000H to FFFFH	0000H

6.2 Application examples with FRENIC Multi

In this section two application examples are described. To avoid incorrect configuration it is recommended to start from factory default values when setting up the inverter (to revert to factory default values set H03=1).

6.2.1 Preset speeds (Multistep frequencies) selection

This example explains how to select preset speeds (multistep frequencies) with FRENIC Multi inverter.

With FRENIC Multi is possible to select up to 15 preset speeds (multistep frequencies). The values of these multistep frequencies are programmed in functions C05 to C19 (in Hz).

To select the multistep frequencies, 4 digital inputs (between X1 to X5, FWD and REV) must be programmed with the functions SS1, SS2, SS4 and SS8 and must be activated according to table 1. Functions E01 to E05, E98 and E99 allow to program the functionality of X1 to X5, FWD and REV digital inputs respectively, according to table 2.

	Multistep Frequency Selected															
Multi Freq.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Func. Code	None	C05	C06	C07	C08	C09	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19
SS1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
SS2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
SS2	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
SS8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
Dec. Value	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Table 1. Multistep frequencies selection.

Digital input functionality	**Value programmed in E01-E05, FWD and REV**	**Decimal value equivalent to binary code**
SS1	0	1
SS2	1	2
SS4	2	4
SS8	3	8

Table 2. Digital inputs functions programming values.

For example, if you want to activate speeds C05 (low frequency) and C07 (high frequency) by using digital inputs X1 and X2, you have to program the functions described in table 3. In this example C05 will be active when X1 input is active, and C07 will be active when both inputs X1 and X2 are active.

Function	**Value**	**Description**
E01	0	Digital input X1 is programmed to activate SS1.
E02	1	Digital input X2 is programmed to activate SS2.
C05	*1	Low frequency (Hz).
C07	*1	High frequency (Hz).

*1. The value of the function depends on the application.

Table 3. Function values for multistep frequencies selection.

Multistep frequencies can be used regardless of the value of function F02 (operation method) and functions F01/C30 (frequency command 1 and 2 respectively). If JOG function is active it has priority over multistep frequencies selection.

A complex frequency command can be generated by adding more than one signal source, depending on the configuration of functions E61, E62 and E63. For more information please refer to chapter 4, section 4.2, “Drive Frequency Command Block”, of FRENIC Multi User’s manual (MEH457).

6.2.2 Dancer control using PID control block

FRENIC Multi is able to perform dancer control by using the PID control block, as shown in figure 1. This control structure is used for example in winding applications.

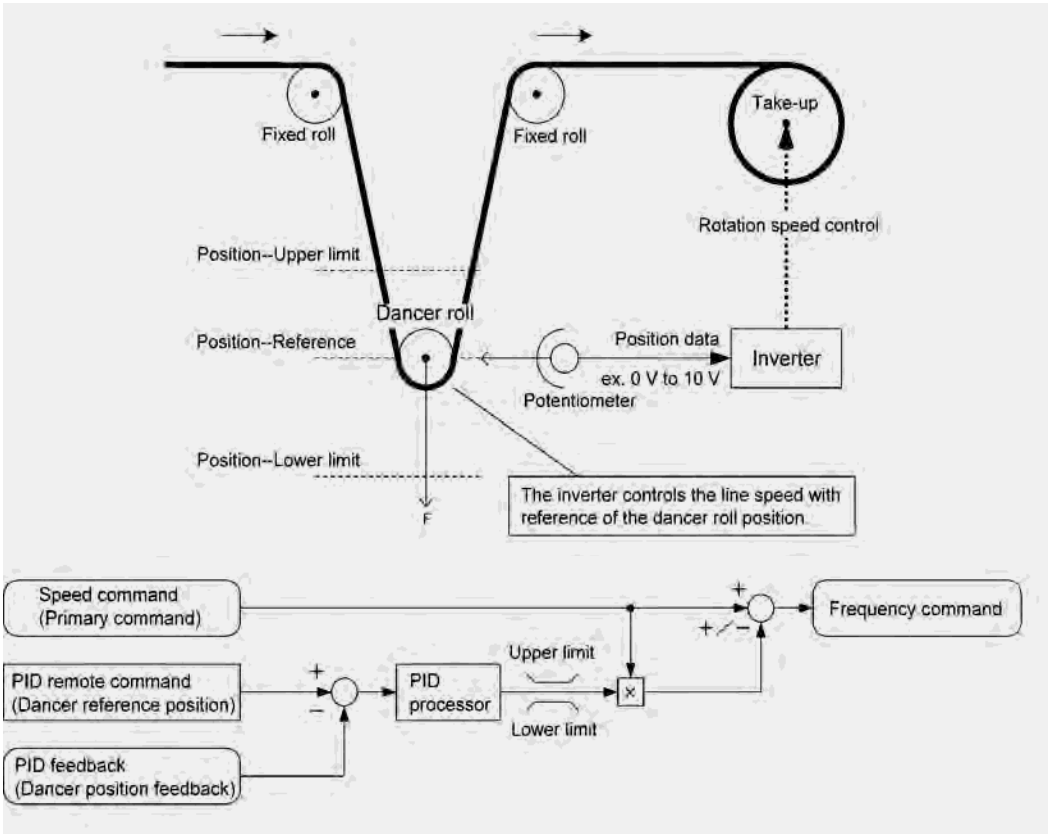


Figure 1. Dancer control.

To use this type of control block J01 has to be programmed to value 3. Also the signal sources for the main speed reference (primary speed command), for the dancer position feedback and the dancer position reference have to be programmed. In this example we will use as the signal source for the primary speed command a 0-10 V analogue signal connected to terminal 12; furthermore we will use as signal source for the dancer position feedback a 0-10 V analogue signal connected to terminal C1/V2 (configured in voltage mode). For the dancer reference (set point) position we will use function J57. The main functions to be programmed are described in table 4.

Function	Value	Description
J01	3	Activates the dancer control
F01	1	Selection of the source for the primary speed command the signal connected to input 12.
J02	0	Selection of the source signal for the dancer reference position (PID command) to the value of function J57. Check that digital inputs are not programmed with functions SS4 or SS8.
J57	50	Set up the value for the dancer reference position (programmed in percentage).
E63	5	Selection of signal connected to input C1/V2 (used in voltage mode) for the dancer feedback position.
J62 (bit 0)	0	Select the polarity of the output signal of the PID process.
J62 (bit 1)	1	Select the output of the PID process as a ratio of the primary speed command.
J03	*1	PID control P gain.
J04	*1	PID control I time (in s).
J10	*1	Anti reset windup function threshold (in percentage).
J18	*1	Upper limit of PID process output.
J19	*1	Lower limit of PID process output.
C35	*1	Polarity of the frequency command. 0: Bipolar; 1: Unipolar.

*1. The value of the function depends on the application.

Table 4. Functions values for PID dancer control.

PID control can be used regardless of the value of function F02 (operation method). A complex frequency command can be generated by adding more than one signal source, depending on the configuration of functions E61, E62 and E63. For more information about these functions and PID dancer control refer to chapter 4, section 4.6, “PID control block”, of FRENIC Multi User’s Manual (MEH457).

7. Troubleshooting

Alarm code	Alarm name	Alarm description
OC1	Overcurrent protection during acceleration	Excessive output current due to: - Excessive motor load. - Acceleration (deceleration) too fast. - Short circuit in the output circuit. - Ground fault (this protection is effective only during start up).
OC2	Overcurrent protection during deceleration	
OC3	Overcurrent protection at constant speed	
OU1	Overvoltage protection during acceleration	Voltage in the DC link too high (400 V for 200 V class inverters; 800 V for 400 V class inverters) due to: - Deceleration too fast. - The motor is regenerating energy and there is no braking resistor connected to the inverter. This protection may not protect the case where the supply voltage is excessive
OU2	Overvoltage protection during deceleration	
OU3	Overvoltage protection at constant speed	
LU	Undervoltage protection	Voltage in the DC link too low (200 V for 200 V class inverters; 400 V for 400 V class inverters). In the case F14=4 or 5, then this alarm does not go off when the voltage in the DC link is low.
Lin	Input phase loss protection	Input phase loss. If the inverter load is low or a DC reactor is installed the event of an input phase loss may be not detected.
OPL	Output phase lost protection	An output phase of the inverter is in open circuit.
OH1	Overheat protection	Excessive heat sink temperature due to: - Inverter fan is not working. - The inverter is overloaded.
dbH	External braking resistor overheat	Overheating of the external braking resistor
OLU	Overload protection	IGBT internal temperature calculated from the output current and from the temperature inside the inverter is over the preset value.
OH2	External alarm input	A digital input is programmed with the function THR (9) and has been deactivated.
OL1	Electronic thermal overload motor 1	The inverter is protecting the motor in accordance with the electronic thermal overload protection setting: - F10 (A06) =1 is for general purpose motors. - F10 (A06)=2 is for inverter motors. - F11 (A07) defines the operation level (current level). - F12 (A08) defines the thermal time constant. F functions are for motor 1 and A functions are for motor 2.
OL2	Electronic thermal overload motor 2	
OH4	PTC thermistor	The thermistor input has stopped the inverter to protect the motor. The thermistor has to be connected between terminals [C1] and [11]. Also the slide switch has to be set to the correct position and functions H26 (enable) and H27 (level) have to be set.
Er1	Memory error detection	Memory error has been detected during power up.
Er2	Keypad communications error detection	The inverter has detected a communications error with the keypad (standard keypad or multifunction keypad).
Er3	CPU error detection	Inverter has detected a CPU error or LSI error caused by noise or some other factors.
Er4	Option communications error detection	Inverter has detected a communications error with the option card.
Er5	Option error detection	The option card has detected an error.

Er6	STOP key priority	If H96=1 or 3, pressing the STOP key on the keypad forces the inverter to decelerate and stop the motor even if the inverter is running by any run commands given via the terminals or communications (link operation). After the motor stops, the inverter issues alarm *Er6*.
	Start check function	The inverter prohibits any run operations and displays *Er6* on the 7-segment LED monitor if any run command is present when: - Powering up - An alarm is released (the PRG RESET key is turned ON or an alarm reset ***RST*** is input.) - "Enable communications link ***LE***" has been activated and the run command is active in the linked source.
Er7	Tuning error detection	During tuning of motor parameters (auto tuning), one of the following errors happened: - tuning has failed. - tuning has been aborted (for example, by removing run command) - an abnormal condition has been detected.
Er8	RS485 communications error detection	The inverter is connected to a communications network via the RS485 port of the keypad and a communications error has been detected.
ErF	Data save error during undervoltage	The data could not be saved during activation of the undervoltage protection function.
ErP	RS485 communications error detection (Optional)	The inverter is connected to a communications network via the optional RS485 communications card (OPC-E1-RS) and a communications error has been detected.
ErH	Hardware error	Hardware error due to: - Poor connection between the control printed circuit board (control PCB) and the power printed circuit board (power PCB), interface printed circuit board (interface PCB) or option card. - Short circuit between terminals 11 and 13.
Err	Mock Alarm	Simulated alarm that can be generated by setting H45=1. This allows to check the fault sequence in an electrical system.
PG	PG disconnection	The signal from the PG has been disconnected when PG feedback card is been used.

For further information about alarm codes please refer to the FRENIC Multi user's manual.

8. SPECIFICATION AND EXTERNAL DIMENSIONS

8.1 Specifications

8.1.1 Three-phase 200 V class series

Item			Specifications										
Type (FRN_ _ _E1S-2☐)			0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Nominal applied motor (kW)		*1	0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Output ratings	Rated capacity (kVA)	*2	0.30	0.57	1.1	1.9	3.0	4.1	6.4	9.5	12	17	22
	Rated voltage (V)	*3	Three-phase 200 to 240 V (with AVR function)										
	Rated current (A)	*4	0.8 (0.7)	1.5 (1.4)	3.0 (2.5)	5.0 (4.2)	8.0 (7.0)	11 (10)	17 (16.5)	25 (23.5)	33 (31)	47 (44)	60 (57)
	Overload capability		150% of rated current for 1 min, 200% - 0.5 s										
	Rated frequency (Hz)		50, 60 Hz										
Input power	Phases, voltage, frequency		Three-phase, 200 to 240 V, 50/60 Hz										
	Voltage/frequency variations		Voltage: +10 to -15% (Voltage unbalance: 2% or less)*9, Frequency: +5 to -5%										
	Rated current (A) *5	(with DCR)	0.57	0.93	1.6	3.0	5.7	8.3	14.0	21.1	28.8	42.2	57.6
		(without DCR)	1.1	1.8	3.1	5.3	9.5	13.2	22.2	31.5	42.7	60.7	80.1
	Required power supply capacity (kVA)	*6	0.2	0.3	0.6	1.1	2.0	2.9	4.9	7.4	10	15	20
Braking	Torque (%)	*7	150		100		70	40		20			
	Torque (%)	*8	150										
	DC braking		Starting frequency: 0.1 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100% of rated current										
	Braking transistor		Built-in										
Applicable safety standards			UL508C, C22.2 No.14, EN50178:1997										
Enclosure (IEC60529)			IP20, UL open type										
Cooling method			Natural cooling				Fan cooling						
Weight / Mass (kg)			0.6	0.6	0.7	0.8	1.7	1.7	2.3	3.4	3.6	6.1	7.1

*1 Fuji 4-pole standard motor

*2 Rated capacity is calculated assuming the output rated voltage as 220 V.

*3 Output voltage cannot exceed the power supply voltage.

*4 Use the inverter at the current enclosed with parentheses ( ) or below when the carrier frequency is set to 4 kHz or above (F26) and the inverter continuously runs at 100% load.

*5 The value is calculated assuming that the inverter is connected with a power supply with the capacity of 500 kVA (or 10 times the inverter capacity if the inverter capacity exceeds 50 kVA) and %X is 5%.

*6 Obtained when a DC reactor (DCR) is used.

*7 Average braking torque obtained when reducing the speed from 60 Hz with AVR control OFF. (It varies with the efficiency of the motor.)

*8 Average braking torque obtained by use of an external braking resistor (standard type available as option)

*9 $$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67 \text{ (IEC 61800 - 3)}$$

If this value is 2 to 3%, use an optional AC reactor (ACR).

Note: A box (☐) in the above table replaces A, C, J, or K depending on the shipping destination.

8.1.2 Three-phase 400 V class series

Item			Specifications								
Type (FRN___E1S-4□)			0.4	0.75	1.5	2.2	3.7 (4.0)*9	5.5	7.5	11	15
Nominal applied motor (kW)		*1	0.4	0.75	1.5	2.2	3.7 (4.0)*9	5.5	7.5	11	15
Output ratings	Rated capacity (kVA)	*2	1.1	1.9	2.8	4.1	6.8	9.9	13	18	22
	Rated voltage (V)	*3	Three-phase 380 to 480 V (with AVR function)								
	Rated current (A)	*4	1.5	2.5	3.7	5.5	9.0	13	18	24	30
	Overload capability		150% of rated current for 1 min, 200% - 0.5 s								
	Rated frequency (Hz)		50, 60 Hz								
Input power	Phases, voltage, frequency		Three-phase, 380 to 480 V, 50/60 Hz								
	Voltage/frequency variations		Voltage: +10 to -15% (Voltage unbalance: 2% or less)*10 Frequency: +5 to -5%								
	Rated current (A)	*5 (with DCR)	0.85	1.6	3.0	4.4	7.3	10.6	14.4	21.1	28.8
		*5 (without DCR)	1.7	3.1	5.9	8.2	13.0	17.3	23.2	33.0	43.8
	Required power supply capacity (kVA)	*6	0.6	1.1	2.0	2.9	4.9	7.4	10	15	20
Braking	Torque (%)	*7	100		70		40		20		
	Torque (%)	*8	150								
	DC braking		Starting frequency: 0.1 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 100% of rated current								
	Braking transistor		Built-in								
Applicable safety standards			UL508C, C22.2 No.14, EN50178:1997								
Enclosure (IEC60529)			IP20, UL open type								
Cooling method			Natural cooling		Fan cooling						
Weight / Mass (kg)			1.1	1.2	1.7	1.7	2.3	3.4	3.6	6.1	7.1

*1 Fuji 4-pole standard motor

*2 Rated capacity is calculated by assuming the output rated voltage as 440 V.

*3 Output voltage cannot exceed the power supply voltage.

*4 Use the inverter at the current enclosed with parentheses ( ) or below when the carrier frequency is set to 4 kHz or above (F26) and the inverter continuously runs at 100% load.

*5 The value is calculated assuming that the inverter is connected with a power supply with the capacity of 500 kVA (or 10 times the inverter capacity if the inverter capacity exceeds 50 kVA) and %X is 5%.

*6 Obtained when a DC reactor (DCR) is used.

*7 Average braking torque obtained when reducing the speed from 60 Hz with AVR control OFF. (It varies with the efficiency of the motor.)

*8 Average braking torque obtained by use of an external braking resistor (standard type available as option)

*9 The nominal applied motor rating of FRN4.0E1S-4E to be shipped to the EU is 4.0 kW.

*10 $$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67 \text{ (IEC 61800 - 3)}$$

If this value is 2 to 3%, use an optional AC reactor (ACR).

Note: A box (□) in the above table replaces A, C, E, J, or K depending on the shipping destination.

8.1.3 Single-phase 200 V class series

Item			Specifications					
Type (FRN_ _ _E1S-7☐)			0.1	0.2	0.4	0.75	1.5	2.2
Nominal applied motor (kW)		*1	0.1	0.2	0.4	0.75	1.5	2.2
Output ratings	Rated capacity (kVA)	*2	0.3	0.57	1.1	1.9	3.0	4.1
	Rated voltage (V)	*3	Three-phase 200 to 240 V (with AVR function)					
	Rated current (A)	*4	0.8 (0.7)	1.5 (1.4)	3.0 (2.5)	5.0 (4.2)	8.0 (7.0)	11 (10)
	Overload capability		150% of rated current for 1 min, 200% - 0.5 s					
	Rated frequency (Hz)		50, 60 Hz					
Input power	Phases, voltage, frequency		Single-phase 200 to 240 V, 50/60 Hz					
	Voltage/frequency variations		Voltage: +10 to -10%, Frequency: +5 to -5%					
	Rated current (A)	*5 (with DCR)	1.1	2.0	3.5	6.4	11.6	17.5
		*5 (without DCR)	1.8	3.3	5.4	9.7	16.4	24.8
	Required power supply capacity (kVA)	*6	0.3	0.4	0.7	1.3	2.4	3.5
Braking	Torque (%)	*7	150		100		70	40
	Torque (%)	*8	150					
	DC braking		Starting frequency: 0.1 to 60.0 Hz, Braking level: 0 to 100% of rated current, Braking time: 0.0 to 30.0 s					
	Braking transistor		Built-in					
Applicable safety standards			UL508C, C22.2 No 14, EN50178:1997					
Enclosure (IEC60529)			IP20, UL open type					
Cooling method			Natural cooling				Fan cooling	
Weight / Mass (kg)			0.6	0.6	0.7	0.9	1.8	2.4

*1 Fuji 4-pole standard motor

*2 Rated capacity is calculated by assuming the output rated voltage as 220 V.

*3 Output voltage cannot exceed the power supply voltage.

*4 Use the inverter at the current enclosed with parentheses ( ) or below when the carrier frequency is set to 4 kHz or above (F26) and the inverter continuously runs at 100% load.

*5 The value is calculated assuming that the inverter is connected with a power supply with the capacity of 500 kVA (or 10 times the inverter capacity if the inverter capacity exceeds 50 kVA) and %X is 5%.

*6 Obtained when a DC reactor (DCR) is used.

*7 Average braking torque obtained when reducing the speed from 60 Hz with AVR control OFF. (It varies with the efficiency of the motor.)

*8 Average braking torque obtained by use of an external braking resistor (standard type available as option)

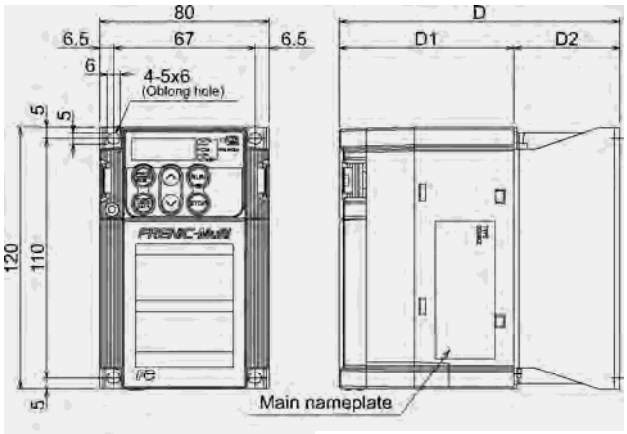
Note: A box (☐) in the above table replaces A, C, E, J, or K depending on the shipping destination.

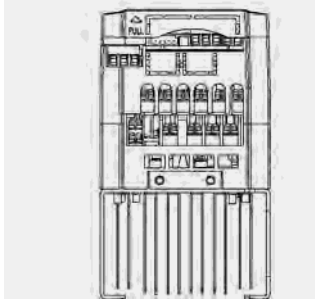
8.2 External dimensions

8.2.1 Inverter dimensions

The diagrams below show external dimensions of the FRENIC-Multi series of inverters according to the type.

FRN0.1E1S-2/7 to FRN0.75E1S-2/7 Units: mm

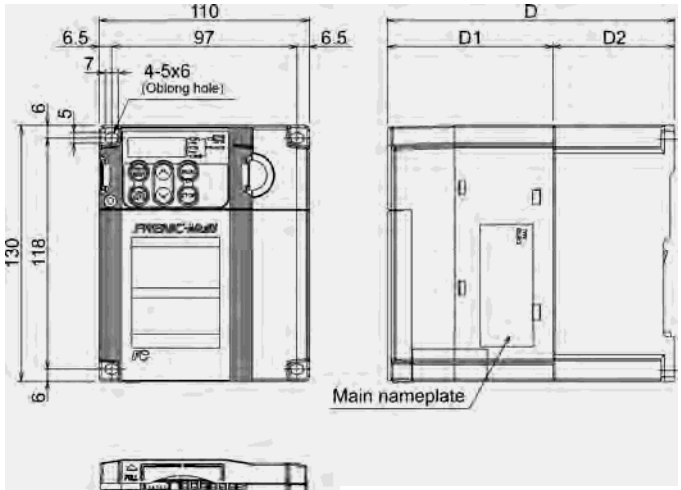


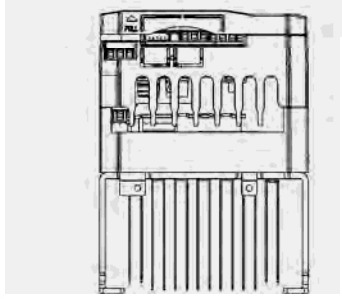


Power supply voltage	Inverter type	Dimensions (mm)		
		D	D1	D2
Three-phase 200 V	FRN0.1E1S-2☐	92	82	10
	FRN0.2E1S-2☐			
	FRN0.4E1S-2☐	107		25
	FRN0.75E1S-2☐	132		50
Single-phase 200 V	FRN0.1E1S-7☐	92	82	10
	FRN0.2E1S-7☐			
	FRN0.4E1S-7☐	107		25
	FRN0.75E1S-7☐	152	102	50

Note: A box (☐) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200 V class series of inverters, it replaces A, C, J, or K.

FRN0.4E1S/E-4 and FRN0.75E1S/E-4

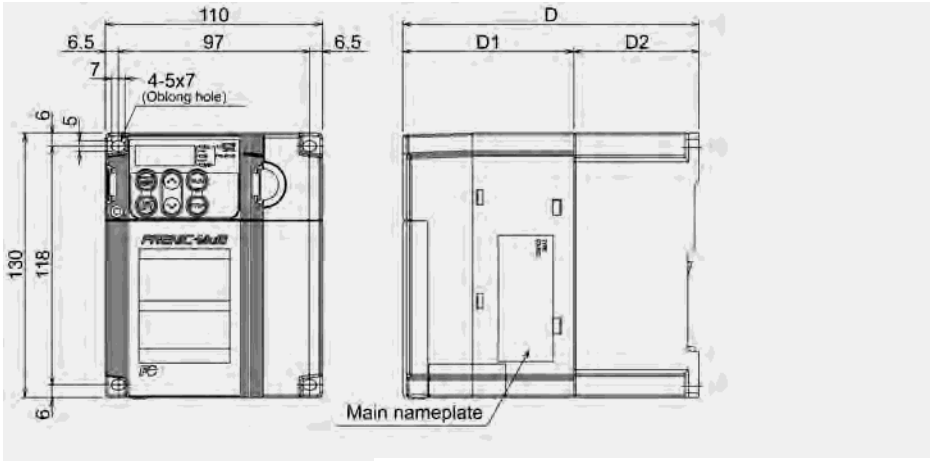


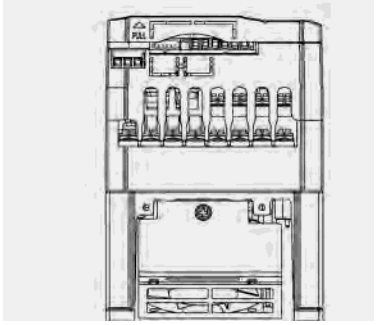


Power supply voltage	Inverter type	Dimensions (mm)		
		D	D1	D2
Three-phase 400 V	FRN0.4E1S-4☐	126	86	40
	FRN0.75E1S-4☐	150		64
	FRN0.4E1E-4☐	169	129	40
	FRN0.75E1E-4☐	193	129	64

Note: A box (☐) in the above table replaces A, C, J, or K depending on the shipping destination.

FRN1.5E1S-2/4/7 and FRN2.2E1S-2/4 Units: mm

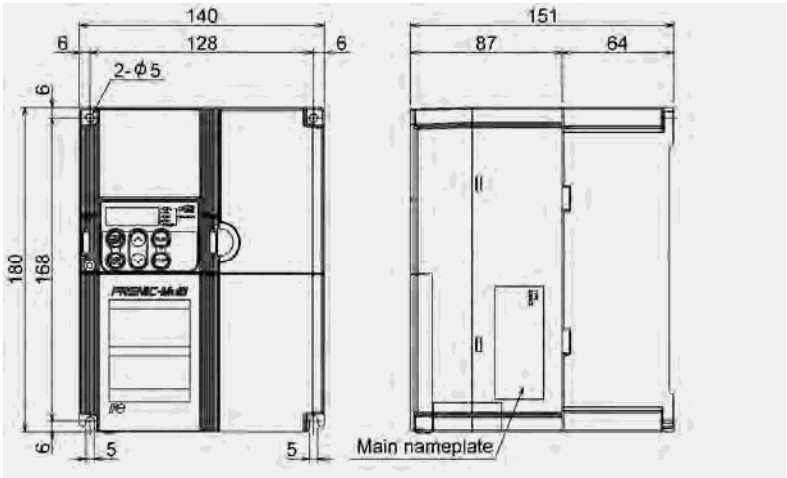


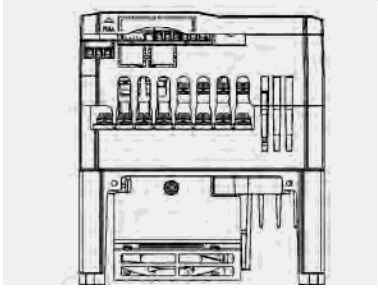


Power supply voltage	Inverter type	Dimensions (mm)		
		D	D1	D2
Three-phase 200 V	FRN1.5E1S-2☐	150	86	64
	FRN2.2E1S-2☐			
Three-phase 400 V	FRN1.5E1S-4☐			
	FRN2.2E1S-4☐			
Single-phase 200 V	FRN1.5E1S-7☐	160	96	

Note: A box (☐) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200 V class series of inverters, it replaces A, C, J, or K.

FRN3.7E1S-2, FRN4.0E1S-4 and FRN2.2E1S-7



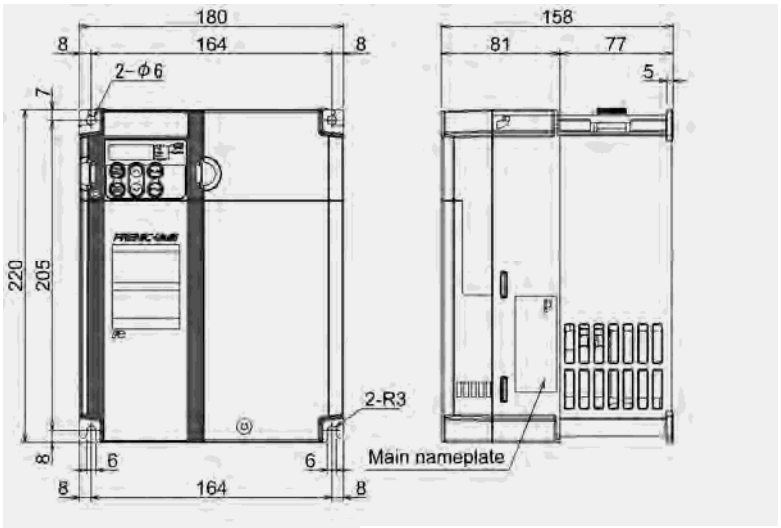


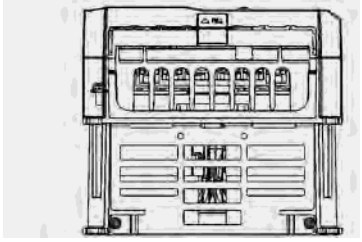
Power supply voltage	Inverter type
Three-phase 200 V	FRN3.7E1S-2☐
Three-phase 400 V	FRN4.0E1S-4E
Single-phase 200 V	FRN2.2E1S-7☐

Note: A box (☐) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200 V class series of inverters, it replaces A, C, J, or K.

FRN5.5E1S-2/4 and FRN7.5E1S-2/4

Units: mm

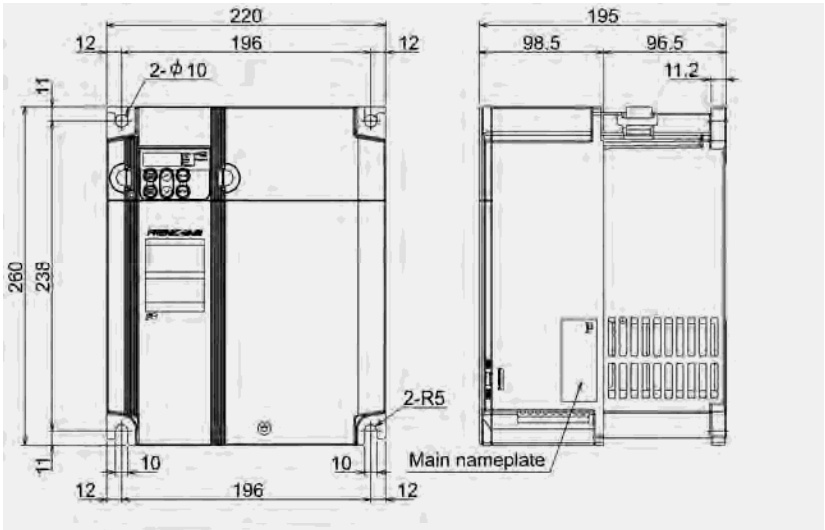


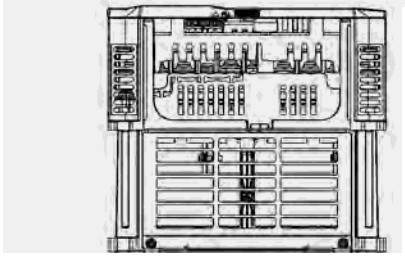


Power supply voltage	Inverter type
Three-phase 200 V	FRN5.5E1S-2☐
	FRN7.5E1S-2☐
Three-phase 400 V	FRN5.5E1S-4☐
	FRN7.5E1S-4☐

Note: A box (☐) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200 V class series of inverters, it replaces A, C, J, or K.

FRN11E1S-2/4 and FRN15E1S-2/4

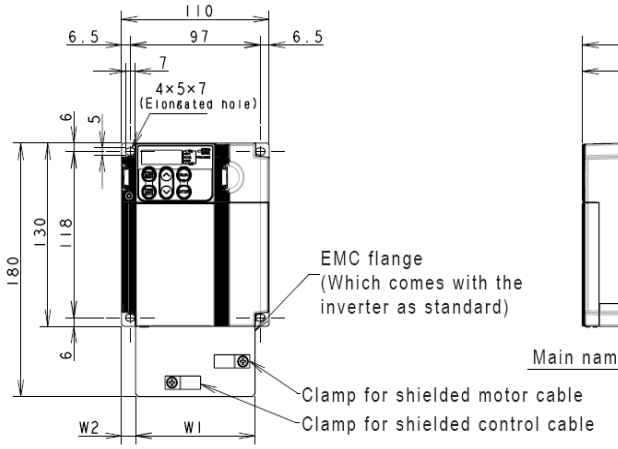


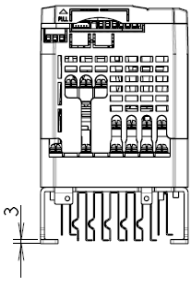


Power supply voltage	Inverter type
Three-phase 200 V	FRN11E1S-2☐
	FRN15E1S-2☐
Three-phase 400 V	FRN11E1S-4☐
	FRN15E1S-4☐

Note: A box (☐) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200 V class series of inverters, it replaces A, C, J, or K.

FRN0.4E1E-4 and FRN0.75E1E-4 Units: mm

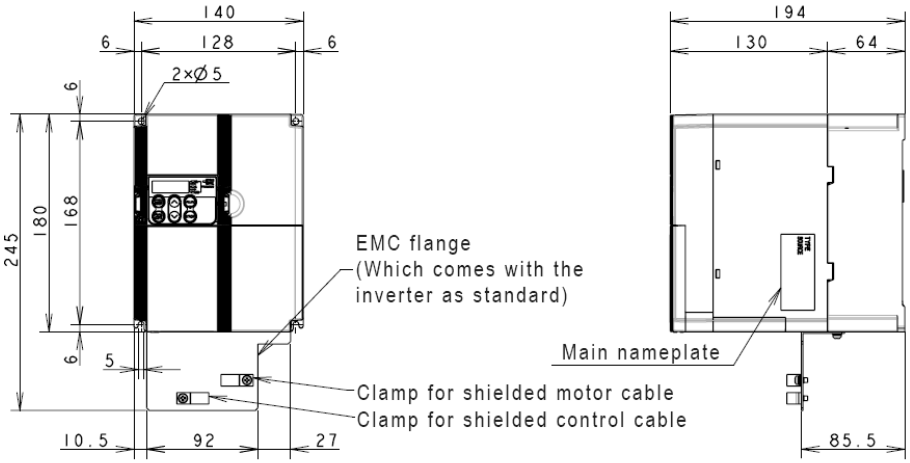


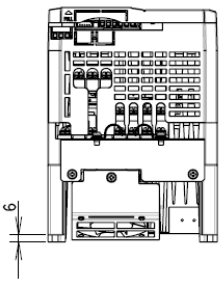


Power supply voltage	Inverter type	Dimensions (mm)					
		W1	W2	D	D1	D2	D3
Three-phase 400V	FRN0.4E1E-4□	89	10.5	169	129	40	61.5
	FRN0.75E1E-4□			193		64	85.5

Note: A box (□) in the above table replaces A, C, E, J, or K depending on the shipping destination.

FRN1.5E1E-4 to FRN4.0E1E-4



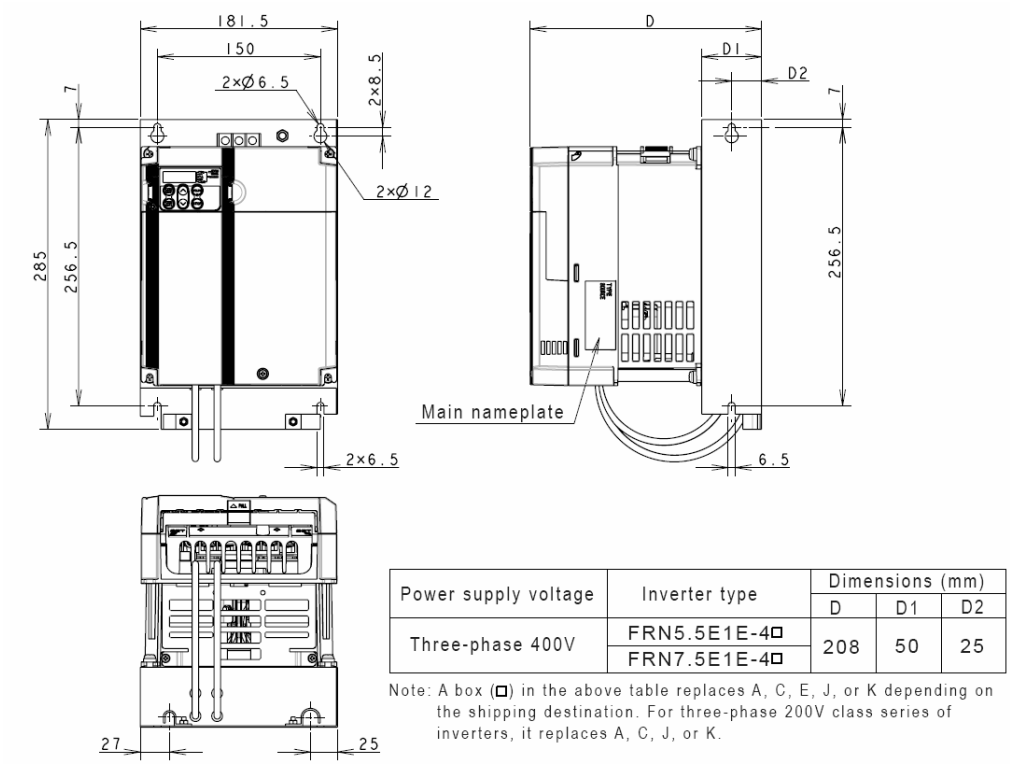


Power supply voltage	Inverter type
Three-phase 400V	FRN1.5E1E-4□
	FRN2.2E1E-4□
	FRN3.7E1E-4□
	FRN4.0E1E-4E*

* The FRN4.0E1E-4E* is for EU.

Note: A box (□) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200V class series of inverters, it replaces A, C, J, or K.

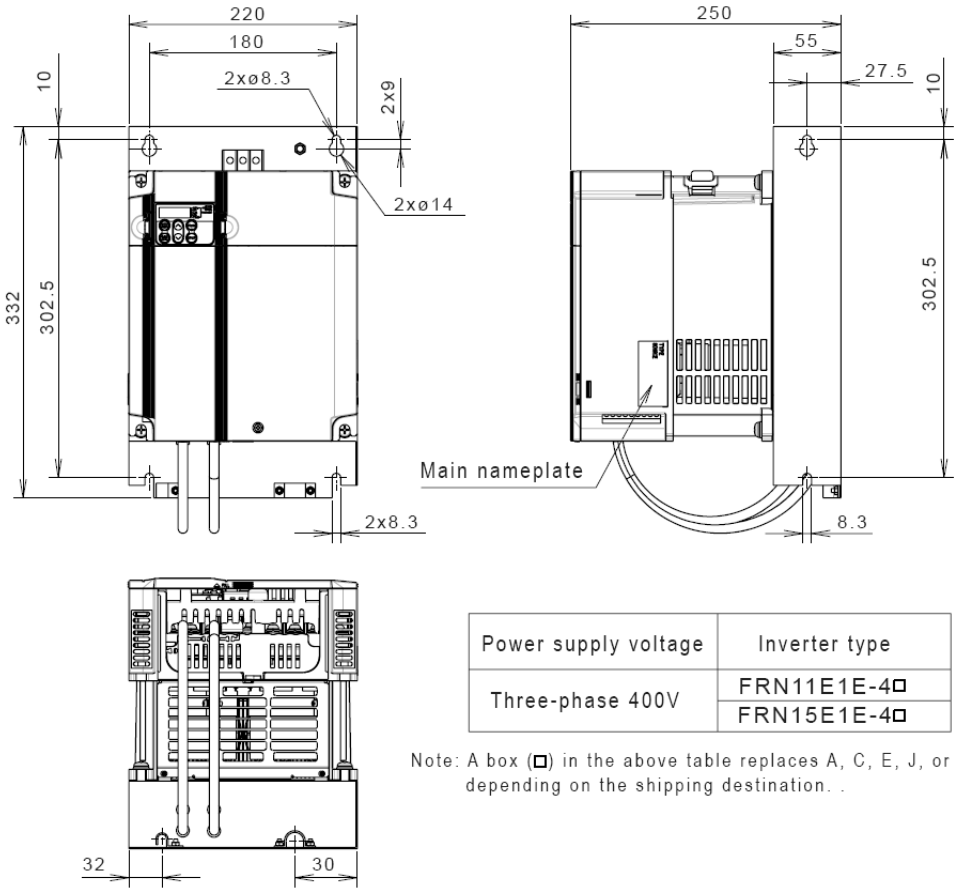
FRN5.5E1E-4 and FRN7.5E1E-4 Units: mm



Power supply voltage	Inverter type	Dimensions (mm)		
		D	D1	D2
Three-phase 400V	FRN5.5E1E-4□	208	50	25
	FRN7.5E1E-4□			

Note: A box (□) in the above table replaces A, C, E, J, or K depending on the shipping destination. For three-phase 200V class series of inverters, it replaces A, C, J, or K.

FRN11E1E-4 and FRN15E1E-4

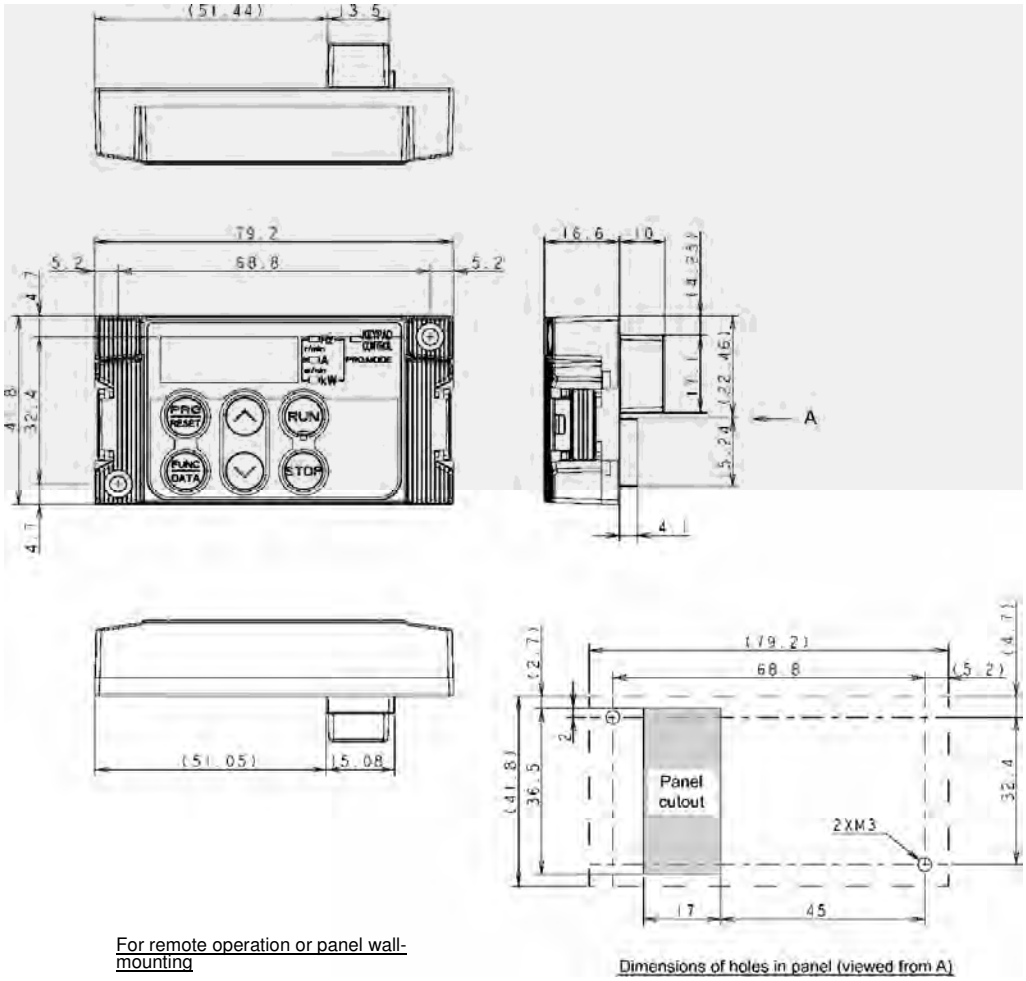


Power supply voltage	Inverter type
Three-phase 400V	FRN11E1E-4□
	FRN15E1E-4□

Note: A box (□) in the above table replaces A, C, E, J, or K depending on the shipping destination. .

8.2.2 Standard keypad dimensions.

Units: mm



For remote operation or panel wall-mounting

(The keypad rear cover should be mounted.)

Dimensions of holes in panel (viewed from A)

9. OPTIONS

9.1 Options table

Option name		Function and application
Main options	DC reactor (DCRE)	The DC reactor is used to reduce harmonic components on the input current (mains supply) of the inverter. **Note:** DO NOT FORGET to remove the DC link bar between P1 and P(+) before installing this option.
	Output filter(OFLE)	Install an output filter between the inverter and the motor to: 1) Suppress the voltage fluctuation at the motor input terminals. 2) Reduce leakage current from the motor power cable (motor supply), due to harmonic components. 3) Reduce emission and induction noise generated from the motor power cable. **Note:** When using an OFLE, set the switching frequency of the inverter (function code F26) within the allowable range specified by the filter manufacturer, otherwise the filter will overheat.
	Ferrite ring reactors (ACL)	The ferrite ring reactors are used to reduce radiated emissions from the inverter.
	EMC input filter	The EMC input filter is used to make the inverter to conform to European EMC directives.
	AC reactor (ACRE)	The AC reactor is connected to the inverter input (mains supply) when the inter-phase voltage unbalance of the AC mains is between 2% and 3%. $\text{Inter - phase voltage unbalance} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{3 phase average voltage (V)}} \times 67$
Operation and communication options	Multi-function keypad (TP-G1)	Allows the user to monitor the status of the inverter (voltage, output current, input power,…), as well as to set parameters values in a conversational mode (6 languages available). It is able to store three complete inverter function sets. It includes a Liquid Crystal Display.
	Extension cable for keypad (CB-..S)	The extension cable allows to connect the keypad to the inverter remotely. Three lengths are available: 5 m (CB-5S), 3 m (CB-3S) y 1 m (CB-1S).
	RS485 Communications card (OPC-E1-RS)	This card adds an additional communications port to the inverter that allows to connect a PLC or PC.
	PG option card (OPC-E1-PG)	This card allows to connect a pulse train signal or a signal from a Pulse Generator. This signal may be used to generate a speed reference or to close the speed and/or position loop. The level of the signal that can be connected to this card is 5 V TTL.
	PG3 option card (OPC-E1-PG3)	This card allows to connect a pulse train signal or a signal from a Pulse Generator. This signal may be used to generate a speed reference or to close the speed and/or position loop. The level of the signal that can be connected to this card is 12~15 V HTL.
	DeviceNet interface card (OPC-E1-DEV)	This card is used to communicate the inverter to a DeviceNet master unit.
	ProfiBus DP interface card (OPC-E1-PDP)	This card is used to communicate the inverter to a ProfiBus DP master unit.
	CC Link interface card (OPC-E1-CCL)	This card is used to communicate the inverter to a device with CC Link interface.
	Additional input-output card (OPC-E1-DIO)	This card is allows to set the frequency reference in Binary or BCD code. Also enables monitoring by using binary code.
	Loader software	PC software, Windows GUI (Graphics user interface) based that allows to set inverter function values more easily. Also allows to upload/download all the function values to/from a file.
	Attachment for external cooling (PB-F1)	With this adapter you can install the inverter in the panel in such a way that the heatsink is outside of the cabinet.

9.2 EMC input filter.

The following table describes the EMC input filter and the EMC compliance level for each inverter capacity.

	Inverter model	EMC input filter	Compliance level
Three phase 400 V supply	FRN0.4E1S-4	FS21559-9-07	C1 conducted emission (25m, 15 kHz) C2 conducted emission(100m, 15 kHz); C1 radiated emission (25m, 15 kHz)
	FRN0.75E1S-4	FS21559-9-07	
	FRN1.5E1S-4	FS21559-9-07	
	FRN2.2E1S-4	FS21559-9-07	
	FRN4.0E1S-4	FS21559-13-07	
	FRN5.5E1S-4	FS21559-24-07	
	FRN7.5E1S-4	FS21559-24-07	
	FRN11E1S-4	FS21559-44-07	C1 conducted emission (25m, 15 kHz); C2 conducted emission (100m, 15 kHz); C2 radiated emission (25m, 15 kHz)
	FRN15E1S-4	FS21559-44-07	
Single phase 200 V supply	FRN0.1E1S-7	FS21558-10-07	C1 conducted emission(25m, 15 kHz) C2 conducted emission (100m, 15 kHz); C1 radiated emission (25m, 15 kHz)
	FRN0.2E1S-7	FS21558-10-07	
	FRN0.4E1S-7	FS21558-10-07	
	FRN0.75E1S-7	FS21558-10-07	
	FRN1.5E1S-7	FS21558-17-07	
	FRN2.2E1S-7	FS21558-25-07	

9.3 DC reactor.

9.3.1 Standard DC reactors

The following table describes the recommended standard DC reactors for each inverter model.

	Inverter model	Standard DC reactors
Three phase 400 V supply	FRN0.4E1S-4	DCRE4-0,4
	FRN0.75E1S-4	DCRE4-0,75
	FRN1.5E1S-4	DCRE4-1,5
	FRN2.2E1S-4	DCRE4-2,2
	FRN4.0E1S-4	DCRE4-4,0
	FRN5.5E1S-4	DCRE4-5,5
	FRN7.5E1S-4	DCRE4-7,5
	FRN11E1S-4	DCRE4-11
	FRN15E1S-4	DCRE4-15
Single phase 200 V supply	FRN0.1E1S-7	DCRE2-0,2
	FRN0.2E1S-7	DCRE2-0,4
	FRN0.4E1S-7	DCRE2-0,75
	FRN0.75E1S-7	DCRE2-1,5
	FRN1.5E1S-7	DCRE2-3,7
	FRN2.2E1S-7	DCRE2-3,7

9.3.2 DC reactors for EN12015 compliance.

The following table describes the DC reactors for EN12015 compliance (with higher inductance).

	Inverter model	DC reactor for EN12015 compliance
Three phase 400V supply	FRN0.75E1S-4	DCRE4-0,75-F
	FRN1.5E1S-4	DCRE4-1,5-F
	FRN2.2E1S-4	DCRE4-2,2-F
	FRN4.0E1S-4	DCRE4-4,0-F
	FRN5.5E1S-4	DCRE4-5,5-F
	FRN7.5E1S-4	DCRE4-7,5-F
	FRN11E1S-4	DCRE4-11-F
	FRN15E1S-4	DCRE4-15-F

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